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Revision 12
4 September 2008

Information technology - SCSI Media Changer Commands - 3 (SMC-3)

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American National Standard
for Information Systems

Draft

SCSI Media Changer Commands–3 (SMC-3)

Secretariat
Information Technology Industry Council

Approved mm dd yy
American National Standards Institute, Inc.

ABSTRACT

This standard defines the SCSI commands and model for media changer devices.

Draft

American National Standard

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Revision Information

1 Revision History

1.1 Revision 0 (4 April 2005)

This is revision 0 of this working draft. This revision incorporates the following proposals approved at the January 2005 T10 meeting by the SMC-3 working group, see 05-047r0:

• 05-026r2 DTE Prevented Medium Removal

This revision also incorporates the following proposals approved at the March 2005 T10 meeting by the SMC-3 working group, see 05-118r0:

• 05-015r2 New ADC-2 command to set Volume Identifier

1.2 Revision 1 (1 November 2005)

Revision 1 incorporates the following proposals approved at the September 2005 T10 meeting by the SMC-3 working group, see 05-353r1:

• 05-070r3 SMC-3 OPEN/CLOSE IMPORT/EXPORT ELEMENT command
• 05-078r5 SMC-3 Extended device capabilities proposal

1.3 Revision 2 (3 May 2006)

Revision 2 incorporates the following proposals approved at the November 2005 and January 2006 T10 meetings by the SMC-3 working group, see 05-431r1 and 06-139r1:

• 05-317r3 SMC-3, SPC-4, SBC-3, and SSC-3: Remove Attached Media Changer model
• 05-368r2 SMC-3 Allow more commands through Write Exclusive
• 05-413r1 SMC-3 Undocumented Element Type Code field in READ ATTRIBUTE command

1.4 Revision 3 (11 August 2006)

Revision 3 incorporates the following proposals approved at the May 2006 T10 meeting:

• 05-243r4 SMC-3, REQUEST DATA TRANSFER ELEMENT INQUIRY command

1.5 Revision 4 (19 September 2006)

Revision 4 incorporates the following proposals approved at the September 2006 T10 meeting, see 06-423r0:

• 05-414r4 SMC-3, Clarification SEND VOLUME TAG command
• 06-046r7 SMC-3, REPORT SUPPORTED VOLUME TYPES command
• 06-182r3 SMC-3, Statistics log page for SMC
• Update references to point to SPC-3 and SAM-3

1.5 Revision 5 (8 March 2007)

Revision 5 incorporates the following proposals approved at the November 2006 T10 telephone conference, see 07-003r1 and January 2007 T10 meeting, see 07-041r0:

• Added definition of Magazine, medium auxillary memory (MAM)
• Edited definitions to match SPC-3 wording
• 06-452r1 SMC-3, Medium type codes

1.6 Revision 6 (16 April 2007)

Revision 6 incorporates the following proposals approved at the March 2007 T10 meeting, see 07-132r0:

• 06-394r3 SMC-3, Element statistics log page for SMC-3
• 07-035r1 SMC-3, RES - Incomplete descriptors
• 06-456r3 SMC-3, Support column in mode page codes and subpage codes table
• 07-024r0 SMC-3, Medium transport element subclause correction

1.7 Revision 7 (16 April 2007)

Revision 7 incorporates the following proposals approved at the May 2007 T10 meeting, see 07-239r0:

- 07-122r1 SMC-3, Clarifying Addresses and Volumes
- 06-442r4 SMC-3, Add PREVENT ALLOW MEDIA REMOVAL command

1.8 Revision 8 (26 June 2007)

Revision 8 incorporates the following proposals approved at the June 2007 telephone conference, see 07-276r0

- 06-477r2 SMC-3, Command table and INQUIRY clean-up
- 07-015r3 SMC-3, Clarifying of reporting drive prevented media removal

1.9 Revision 9 (12 September 2007)

Revision 9 incorporates the following proposals approved at the July 2007 T10 meeting, see 07-324r0

- 06-395r5 SMC-3, Diagnostics Data log page
- 07-199r1 SMC-3, POSITION TO ELEMENT command clarification

1.10 Revision 10 (31 December 2007)

Revision 10 incorporates the following proposals approved at the July 2007 T10 meeting, see 07-489r1

- 07-222r2 SMC-3, Additional sense code for incompatible destination element
- 07-244r3 SMC-3, READ ATTRIBUTE and WRITE ATTRIBUTE command clarification

1.11 Revision 11 (25 February 2008)

Revision 11 incorporates the following proposals approved at the January 2008 T10 meeting, see 08-045r2

- 07-018r2 SMC-3, New Additional Sense Codes Usage

1.12 Revision 12 (4 September 2008)

Revision 12 incorporates the following proposals approved at the August 2008 SMC-3 Telephone conferences, see 08-335r0 and 08-334r0, and at the January CAP meeting, see 08-061r0.

- 07-454r5 Capability-based Command Security
- 08-038r4 SMC-3, Use of LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED
- 08-047r3 SMC-3, New tape alert flags

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Foreword

The SCSI Media Changer Commands – 3 (SMC-3) standard specifies the commands and external behavioral characteristics of a device server that declares itself a media changer in the PERIPHERAL DEVICE TYPE field of the INQUIRY command response data.

SMC-3 is specified independent of any service delivery subsystem used to carry commands, command parameter data, command response data and status. The SMC-3 standard conforms to the requirements specified in the SCSI-3 Architecture Model standard.

With any technical document there may arise questions of interpretation as new products are implemented. The INCITS committee has established procedures to issue technical opinions concerning the standards developed by the INCITS organization. These procedures may result in SCSI Technical Information Bulletins being published by INCITS.

These bulletins, while reflecting the opinion of the Technical Committee which developed the standard, are intended solely as supplementary information to users of the standard. This standard, ANSI INCITS.xxx-200x, as approved through the publication and voting procedures of the American National Standards Institute, is not altered by these bulletins. Any subsequent revision to this standard may or may not reflect the contents of these Technical Information Bulletins.

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Requests for interpretation, suggestions for improvement and addenda, or defect reports are welcome. They should be sent to the INCITS Secretariat, National Committee for Information Technology Standards, Information Technology Institute, 1250 Eye Street, NW, Suite 200, Washington, DC 20005-3922.

This standard was processed and approved for submittal to ANSI by the National Committee for Information Technology Standards (INCITS). Committee approval of the standard does not necessarily imply that all committee members voted for approval. At the time it approved this standard, INCITS had the following members:

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Introduction

The SCSI Media Changer Command Set (SMC-3) standard is divided into seven clauses:

Clause 1 is the scope.

Clause 2 enumerates the normative and informative references that apply to this standard.

Clause 3 describes definitions, symbols, abbreviations and conventions used in this standard.

Clause 4 is an overview of this standard.

Clause 5 describes the model for this device class.

Clause 6 describes the commands and responses.

Clause 7 describes the parameters.

One annex provides information to assist with implementation and understanding of the requirements and recommendations in this standard:

Annex A defines flags used by the TapeAlert mode page.

AMERICAN NATIONAL STANDARD **BSR INCITS XXX-200X**

American National Standard for
Information Technology –

SCSI Media Changer Commands (SMC-3)

1 Scope

This standard defines the command set extensions for operation of SCSI media changer devices, and command set extensions that allow media changer functions in other types of SCSI devices.

The objectives of the SCSI-3 Media Changer Commands – 3 standard are:

a) to permit an application client to communicate with a logical unit that declares itself to be a media changer device in the PERIPHERAL DEVICE TYPE field of the INQUIRY command response data; and
b) to define commands and parameter data to manage the operation of SCSI media changer devices.

This standard makes obsolete the following commands and concepts from previous standards:

a) the READ ELEMENT STATUS ATTACHED command;
b) the MOVE MEDIUM ATTACHED command; and
c) the attached media changer model.

The set of SCSI standards specifies the interfaces, functions, and operations necessary to ensure interoperability between conforming SCSI implementations. This standard is a functional description.

Conforming implementations may employ any design technique that does not violate interoperability. Figure 1 is intended to show the general structure of SCSI standards. Figure 1 is not intended to imply a relationship such as a hierarchy, protocol stack, or system architecture.

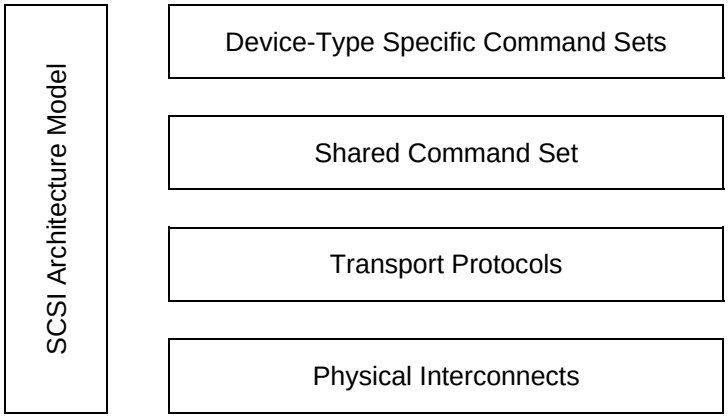

Figure 1 — General structure of SCSI standards

At the time this standard was generated, examples of the SCSI general structure included:

Interconnects:

Fibre Channel Arbitrated Loop – 2	FC-AL-2	[ISO/IEC 14165-122] [ANSI NCITS.332-1999] [ANSI NCITS.332-1999/AM1]
Fibre Channel Physical Interfaces	FC-PI	[ANSI INCITS.352-2002]
Fibre Channel Physical Interfaces – 2	FC-PI-2	[T11/1506-D]
Fibre Channel Framing and Signaling Interface	FC-FS	[T11/1331-D]
High Performance Serial Bus		[ANSI IEEE 1394-1995]
High Performance Serial Bus		[ANSI IEEE 1394a-2000] (supplement to ANSI/IEEE 1394-1995)
SCSI Parallel Interface – 2	SPI-2	[ISO/IEC 14776-112] [ANSI X3.302-1999]
SCSI Parallel Interface – 3	SPI-3	[ISO/IEC 14776-113] [ANSI NCITS.336-2000]
SCSI Parallel Interface – 4	SPI-4	[ISO/IEC 14776-114] [ANSI INCITS.362-2002]
SCSI Parallel Interface – 5	SPI-5	[ISO/IEC 14776-115] [ANSI INCITS.367:200x]
Serial Storage Architecture Physical Layer 1	SSA-PH	[ANSI X3.293-1996]
Serial Storage Architecture Physical Layer 2	SSA-PH-2	[ANSI NCITS.307-1998]
Serial Attached SCSI	SAS	[T10/1562-D]
Serial Attached SCSI – 2	SAS-2	[T10/1601-D]

SCSI Transport Protocols:

Automation/Drive Interface – Transport Protocol	ADT	[T10/1557-D]
Serial Storage Architecture Transport Layer 1	SSA-TL-1	[ANSI X3.295-1996]
Serial Storage Architecture Transport Layer 2	SSA-TL-2	[ANSI NCITS.308-1998]
SCSI-3 Fibre Channel Protocol	FCP	[ISO/IEC 14776-221] [ANSI X3.269-1996]
SCSI Fibre Channel Protocol – 2	FCP-2	[ISO/IEC 14776-222] [ANSI NCITS.350-2003]
SCSI Fibre Channel Protocol – 3	FCP-3	[ISO/IEC 14776-223] [T10/1560-D]
Serial Bus Protocol – 2	SBP-2	[ISO/IEC 14776-232] [ANSI NCITS.325-1999]
Serial Bus Protocol – 3	SBP-3	[ISO/IEC 14776-233] [T10/1467-D]
Serial Storage Architecture SCSI-3 Protocol	SSA-S3P	[ANSI NCITS.309-1998]
SCSI RDMA Protocol	SRP	[T10/1415-D]

Shared Command Sets:

SCSI-3 Primary Commands	SPC	[ISO/IEC 14776-311] [ANSI X3.301-1997]
SCSI Primary Commands – 2	SPC-2	[ISO/IEC 14776-312] [ANSI NCITS.351-2001]
SCSI Primary Commands – 3	SPC-3	[ISO/IEC 14776-313] [T10/1416-D]

Device-Type Specific Command Sets:

SCSI-3 Block Commands	SBC	[ISO/IEC 14776-321] [ANSI NCITS.306-1998]
SCSI Block Commands – 2	SBC-2	[ISO/IEC 14776-322] [T10/1417-D]
SCSI-3 Stream Commands	SSC	[ISO/IEC 14776-331] [ANSI NCITS.335-2000]
SCSI Stream Commands – 2	SSC-2	[ISO/IEC 14776-332] [T10/1434-D]
SCSI Stream Commands – 3	SSC-3	[ISO/IEC 14776-333] [T10/1611-D]
SCSI-3 Medium Changer Commands	SMC	[ISO/IEC 14776-351] [ANSI NCITS.314-1998]
SCSI Media Changer Commands – 2	SMC-2	[ISO/IEC 14776-352] [T10/1383-D]
SCSI-3 Multimedia Command Set	MMC	[ANSI X3.304-1997]
SCSI Multimedia Command Set – 2	MMC-2	[ISO/IEC 14776-362] [ANSI NCITS.333-2000]
SCSI Multimedia Command Set – 3	MMC-3	[ISO/IEC 14776-363] [ANSI INCITS.360-2002]
SCSI Multimedia Command Set – 4	MMC-4	[ISO/IEC 14776-364] [T10/1545-D]
SCSI Controller Commands – 2	SCC-2	[ISO/IEC 14776-342] [ANSI NCITS.318-1998]
SCSI Reduced Block Commands	RBC	[ISO/IEC 14776-326] [ANSI NCITS.330-2000]
SCSI-3 Enclosure Services Commands	SES	[ISO/IEC 14776-371] [ANSI NCITS.305-1998]
SCSI Enclosure Services Commands – 2	SES-2	[ISO/IEC 14776-372] [T10/1559-D]
SCSI Specification for Optical Card Reader/Writer	OCRW	[ISO/IEC 14776-381]
Object-based Storage Devices Commands	OSD	[T10/1355-D]
SCSI Management Server Commands	MSC	[T10/1528-D]
Automation/Drive Interface – Commands	ADC	[T10/1558-D]

Architecture Model:

SCSI-3 Architecture Model	SAM	[ISO/IEC 14776-411] [ANSI X3.270-1996]
SCSI Architecture Model – 2	SAM-2	[ISO/IEC 14776-412] [ANSI INCITS.366-2003]
SCSI Architecture Model – 3	SAM-3	[ISO/IEC 14776-413] [T10/1561-D]

The term SCSI is used to refer to the family of standards described in this clause.

2 Normative references

2.1 Normative references overview

The following standards contain provisions that, through reference in the text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below.

Copies of the following documents may be obtained from ANSI: Approved ANSI standards, approved and draft international and regional standards (ISO, IEC, CEN/CENELEC, ITUT), and approved standards of other countries (including BSI, JIS, and DIN). For further information, contact ANSI Customer Service Department at 212–642–4900 (telephone), 212–302–1286 (fax) or via the World Wide Web at http://www.ansi.org.

2.2 Approved references

ISO/IEC 14776-413, SCSI Architecture Model – 3 (SAM-3) [ANSI INCITS.402-2005]

ISO/IEC 14776-452, SCSI Primary Commands – 2 (SPC-2) [ANSI INCITS.351-2001]

ISO/IEC 14776-115, SCSI Parallel Interface – 5 (SPI-5) [ANSI INCITS.367-2003]

ISO/IEC 14776-222, SCSI Fibre Channel Protocol – 2 (FCP-2) [ANSI INCITS.350-2003]

ISO/IEC 14776-352, SCSI-3 Media Changer Commands (SMC) [ANSI INCITS.314-1998]

ISO/IEC 14776-331, SCSI-3 Stream Commands (SSC) [ANSI INCITS.335-2000]

ANSI INCITS.382-2004, SCSI Media Changer Commands – 2 (SMC-2)

ANSI INCITS.380-2003, SCSI Stream Commands (SSC-2)

ANSI INCITS.403-2005, Automation/Drive Interface, Commands (ADC)

2.3 References under development

At the time of publication, the following referenced standards were still under development. For information on the current status of the document, or regarding availability, contact the relevant standards body or other organization as indicated.

T10/1731-D, SCSI Primary Commands – 4 (SPC-4)

T10/1741-D, Automation/Drive Interface, Commands – 2 (ADC-2)

T10/1611-D, SCSI Stream Commands – 3 (SSC-3)

3 Definitions, symbols and abbreviations

3.1 Definitions

3.1.1 additional sense code: A combination of the ADDITIONAL SENSE CODE and ADDITIONAL SENSE CODE QUALIFIER fields in the sense data (see SPC-3).

3.1.2 application client: An object that is the source of SCSI commands. Further definition of an application client may be found in SAM-3.

3.1.3 byte: A sequence of 8 contigous bits considered as a unit.

3.1.4 command: A request describing a unit of work to be performed by a device server. A detailed definition of a command may be found in SAM-3.

3.1.5 command descriptor block (CDB): The structure used to communicate commands from an application client to a device server.

3.1.6 data transfer device: A device for reading or writing data on medium. Examples are magnetic disk drives, cartridge tape drives, optical disk drives and CD-ROM drives. Use in a media changer environment implies that the device supports removable volumes.

3.1.7 data transfer element: A component of a media changer used to access the data stored on a volume. The address in media changer element space of a data transfer device.

3.1.8 device service request: A request, submitted by an application client, conveying a SCSI command to a device server. A detailed definition of a device service request may be found in SAM-3.

3.1.9 device type: The type of peripheral device (or device model) implemented by the device server and indicated by the contents of the PERIPHERAL DEVICE TYPE field in the standard INQUIRY data (see SPC-3).

3.1.10 element: An addressable physical component of a media changer device that may serve as the location of a removable unit of data storage medium.

3.1.11 field: A group of one or more contiguous bits, a part of a larger structure such as a CDB or sense data (see SPC-3).

3.1.12 form factor: The external physical characteristics of a volume that affect the fit of the volume in any element.

3.1.13 hard reset: A condition resulting from the events defined by SAM-3 in which the SCSI device performs the hard reset operations described in SAM-3, and SPC-3.

3.1.14 inventory scan: An action performed by a media changer where the inventory of some or all volumes and the element address at which they may be found is determined.

3.1.15 import/export element: A location within a media changer device that may be accessed by both the medium transport elements and by the operator or an external device.

3.1.16 linked command: One in a series of SCSI commands processed by a single task that collectively make up a discrete I/O operation. A detailed definition of a linked command may be found in SAM-3.

3.1.17 logical unit: An externally addressable entity within a SCSI target device that implements a SCSI device model and contains a device server. A detailed definition of a logical unit may be found in SAM-3.

3.1.18 logical unit number (LUN): An encoded 64-bit identifier for a logical unit. A detailed definition of a logical unit number may be found in SAM-3.

3.1.19 logical unit reset: A condition resulting from the events defined by SAM-3 in which the logical unit performs the logical unit reset operations described in SAM-3, and SPC-3.

3.1.20 magazine: A structure consisting of one or more import/export elements or storage elements that is used to contain a set of volumes within the media changer. Some media changer devices allow an operator to remove the magazine from the media changer.

3.1.21 media changer: A device that mechanizes the movement of media to and from the SCSI device that records on or reads from the media.

3.1.22 medium: A physical entity that stores data in a nonvolatile manner (ie., retained through a power cycle), equivalent to volume as defined in this standard.

3.1.23 medium auxillary memory (MAM): An auxiliary memory residing on a medium that is accessible to the device server (e.g. a tape cartridge). Medium auxiliary memory may be nonvolatile and independent of the main function of the device server.

3.1.24 medium transport element: A component of a media changer device that is used to move volumes.

3.1.25 one: The logical true condition of a variable.

3.1.26 page: A regular parameter structure (or format) used by several commands. These pages are identified with a value known as a page code.

3.1.27 protocol specific: A requirement that is defined by a SCSI transport protocol standard. A detailed definition of protocol specific may be found in SAM-3.

3.1.28 SCSI device: A device that icontains one or more SCSI ports that are connected to a service delivery subsystem and supports a SCSI application protocol. A detailed definition of a SCSI device may be found in SAM-3.

3.1.29 SCSI domain: The interconnection of two or more SCSI devices and a service delivery subsystem. A detailed definition of a SCSI domain may be found in SAM-3.

3.1.30 RMC device server: A device server that supports a removable medium command set (e.g., SSC-2 or MMC-4). See ADC.

3.1.31 SCSI initiator device: A SCSI device containing application clients and SCSI initiator ports that originate device service and task management requests to be processed by a SCSI target device and receives device service and task management responses from SCSI target devices. A detailed definition of a SCSI initiator device may be found in SAM-3.

3.1.32 SCSI initiator port: A SCSI initiator device object that acts as the connection between application clients and the service delivery subsystem through which requests and responses are routed. A detailed definition of SCSI target port may be found in SAM-3.

3.1.33 SCSI target device: A SCSI device containing logical units and SCSI target ports that receives device service and task manament requests for processing and sends device service and task management responses to SCSI initiator devices. A detailed definition of a SCSI target device may be found in SAM-3.

3.1.34 SCSI target port: A SCSI target device object that acts as the connection between device servers and task managers and the service delivery subsystem through which requests and responses are routed. A detailed definition of SCSI target port may be found in SAM-3.

3.1.35 sense data: Data describing an error or exceptional condition that a device server delivers to an application client in the same I_T_L_Q nexus transction as a CHECK CONDITION status or in response to a REQUEST SENSE command (see SPC-3).

3.1.36 sense key: Contents of the SENSE KEY field in the sense data.

3.1.37 service delivery subsystem: That part of a SCSI I/O system that transmits service requests to a logical unit or SCSI target device and returns logical unit or SCSI target device responses to a SCSI initiator device. A detailed definition of a service delivery subsystem may be found in SAM-3.

3.1.38 status: One byte of response information sent from a device server to an application client upon completion of each command. A detailed definition of status may be found in SAM-3.

3.1.39 storage element: A component of a media changer device used only for physical storage of a volume.

3.1.40 system: One or more SCSI domains operating as a single configuration.

3.1.41 task: An object within a logical unit that represents the work associated with a command or a group of linked commands. A detailed definition of a task may be found in SAM-3.

3.1.42 task set: A group of tasks within a logical unit, whose interaction is dependent on the task management (queuing) and contingent allegiance and auto contingent allegiance rules. See SAM-3.

3.1.43 unit attention condition: A state that a logical unit maintains while it has asynchronous status information to report to the initiator ports associated with one or more I_T nexusses. A detailed definition of the unit attention condition may be found in SAM-3.

3.1.44 vendor-specific: Something (e.g., a bit, field, code value, etc.) that is not defined by this standard and may be vendor defined.

3.1.45 volume: The recording medium and its carrier that is removable from a data transfer device and may be moved from one element to another by a media changer.

3.1.46 volume rotation: The process of changing the orientation of a volume. In particular this refers to inverting a two-sided volume cartridge so that a data transfer element that accesses only one side at a time may access data on the other side.

3.1.47 zero: The logical false condition of a variable.

3.2 Symbols and abbreviations

= is equal to

ADC Automation/Drive Interface Commands standard

CbCS Command-base command security

CDB command descriptor block

I/O input/output

ID identifier

LSB least significant bit

LUN logical unit number

MAM medium auxillary memory

MSB most significant bit

MMC-4 SCSI Multi–Media Commands – 4 standard

RSVD reserved field or bit

SAM-2 SCSI-3 Architecture Model – 2 standard

SBC-2 SCSI-3 Block Commands – 2 standard

SCSI-3 Only standards identified in the foreword as being part of the SCSI-3 standard document set

SMC-3 SCSI Media Changer Commands – 3, this standard

SPC-2 SCSI Primary Commands – 2 standard

SPC-3 SCSI Primary Commands – 3 standard

SSC-2 SCSI-3 Stream Commands – 2 standard

3.3 Keywords

3.3.1 expected: A keyword used to describe the behavior of the hardware or software in the design models assumed by this standard. Other hardware and software design models may also be implemented.

3.3.2 invalid: A keyword used to describe an illegal or unsupported bit, byte, word, field or code value. Receipt of an invalid bit, byte, word, field or code value shall be reported as error.

3.3.3 mandatory: A keyword indicating an item that is required to be implemented as defined in this standard.

3.3.4 may: A keyword that indicates flexibility of choice with no implied preference.

3.3.5 may not: A keyword that indicates flexibility of choice with no implied preference**.**

3.3.6 obsolete: A keyword indicating that an item was defined in prior SCSI standards but has been removed from this standard.

3.3.7 optional: A keyword that describes features that are not required to be implemented by this standard. However, if any optional feature defined by this standard is implemented, then it shall be implemented as defined in this standard.

3.3.8 reserved: A keyword referring to bits, bytes, words, fields and code values that are set aside for future standardization. A reserved bit, byte, word or field shall be set to zero, or in accordance with a future version of this standard. Recipients may check reserved bits, bytes, words or fields for zero values and report errors if non-zero values are received. Receipt of reserved code values in defined fields shall be reported as error.

3.3.9 shall: A keyword indicating a mandatory requirement. Designers are required to implement all such mandatory requirements to ensure interoperability with other products that conform to this standard**.**

3.3.10 should: A keyword indicating flexibility of choice with a strongly preferred alternative; equivalent to the phrase “it is strongly recommended.”

3.4 Conventions

Certain words and terms used in this standard have a specific meaning beyond the normal English meaning. These words and terms are defined either in or in the text where they first appear. Names of commands, statuses, sense keys, additional sense codes, and additional sense code qualifiers are in all uppercase (e.g., REQUEST SENSE). Field names and bit names are in SMALL CAPS. Lower case is used for words having the normal English meaning.

Fields containing only one bit are usually referred to as the name bit instead of the name field.

Numbers that are not immediately followed by lowercase b or h are decimal values.

Numbers immediately followed by lowercase b (xxb) are binary values.

Numbers or upper case letters immediately followed by lowercase h (xxh) are hexadecimal values.

Lists sequenced by letters (e.g., a-red, b-blue, c-green) show no priority relationship between the listed items. Numbered lists (e.g., 1-red, 2-blue, 3-green) show a priority ordering between the listed items.

If a conflict arises between text, tables, or figures, the order of precedence to resolve the conflicts is text; then tables; and finally figures. Not all tables or figures are fully described in the text. Tables show data format and values. NOTES do not constitute any requirements for implementors.

4 Overview

The SCSI media changer device class specifies a logical unit that is involved, primarily, with the movement of removable volumes in a controlled environment without human intervention. The SCSI device classes that provide for removable volumes are block, multimedia and sequential. (See the SBC-2, MMC-4 and SSC-2 standards.)

A media changer logical unit receives commands to move volumes between various element types in the element address space of the media changer. The element types are storage, data transfer, medium transport, and import/export. A volume handling robotics subsystem, addressed as a medium transport element, moves volumes within a media changer. Volumes may also be moved between media changers with interconnected import/export ports.

A media changer logical unit maintains an inventory of volumes and the element addresses at which they may be found. The media changer logical unit reports this inventory when requested and identifies the element addresses assigned to different types of elements.

Different levels of sophistication may be implemented in how this inventory is managed, reported, detected and maintained.

In some cases, the data transfer device associated with a data transfer element may not be a SCSI device.

Figure 2 shows an example of a media changer. The data transfer elements (data transfer devices) shown may be any type of removable media device such as a tape drive, disk drive or optical drive. Supporting multiple types of removable media within the same media changer is also permitted. Also, the ports on each data transfer device may or may not attach to the same service delivery subsystem and the interfaces to the data transfer devices may or may not be SCSI target ports. The number and arrangement of elements is arbitrary.

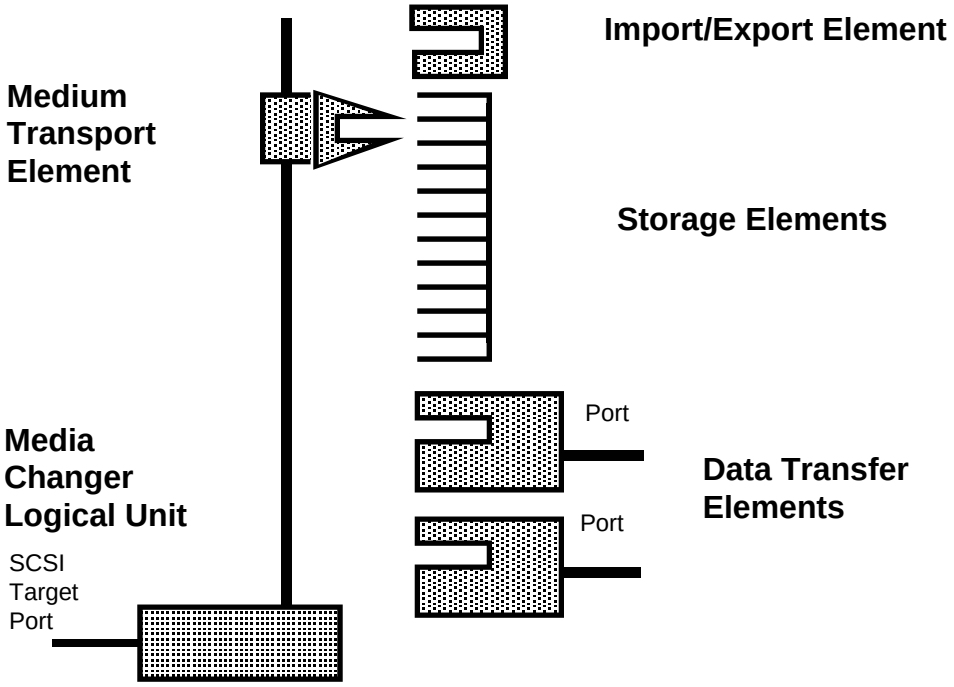

Figure 2 — Example media changer device

The media changer is addressed as a separate logical unit. The logical unit for the media changer may be accessed via the same SCSI target port as the data transfer device, or via a different SCSI target port. A media changer may support more than one data transfer element.

A media changer moves volumes among the elements accessible to it on command from an application client. Media changers shall be capable of reporting the full or empty status of any element.

5 Media changer model

5.1 Introduction

A media changer is a device server that returns 08h (i.e., medium changer) in the PERIPHERAL DEVICE TYPE field (see SPC-3) of the standard INQUIRY data.

Communication with a data transfer device may use the same service delivery subsystem as the media changer device, or a different SCSI service delivery subsystem. Data transfer devices that are not SCSI devices are also permitted. Multiple data transfer devices may be attached to a media changer.

If a data transfer device served by the media changer is a SCSI device, then the data transfer device may be addressed on a SCSI service delivery subsystem through the same SCSI target port as the media changer but with a different LUN. The data transfer device may also be addressed through independent SCSI target ports and any LUN on the same or a different service delivery subsystem.

The READ ELEMENT STATUS command response data page for each data transfer element may provide the identity of the data transfer device serviced by a media changer device. This support is optional since a data transfer device is not required to be a SCSI device.

A media changer shall set the MCHNGR bit in the standard INQUIRY data to zero (see SPC-3)

5.2 Media changer elements

5.2.1 Elements overview

A media changer has an address space separate and distinct from the physical address space of a SCSI-3 service delivery subsystem. The term element is used throughout this standard to refer to one member of the media changer address space. Within a media changer, the element addresses are a set of physical locations and mechanisms within the scope of a media changer device.

Each element is an instance of one of four element types:

a) medium transport element;
b) storage element;
c) import/export element; or
c) data transfer element.

Each element is a discrete physical entity with a unique element address that may provide storage for zero or one volume. A volume is in exactly one element at a time. When a volume is moving from one element to another, the point in time when the source element status and destination element status are changed is not specified by this standard. When the device server is requested to report element status, a volume shall be reported as being at exactly one element address. The element address shall not be arbitrarily changed by the media changer. In configurations with multiple initiators, volumes may be moved between elements by one application client without notification of other application clients.

Volumes are addressed indirectly by this model. Volumes may be moved to or from any of the elements of the media changer device using element addresses. The method of detecting the presence of a volume at any element in a media changer is vendor specific.

Providing independent storage for medium is optional for medium transport, import/export, and data transfer elements. The capabilities of a particular media changer may be determined from mode parameters in the Device Capabilities mode page (see 7.3.2).

NOTE 1 — An example of an element not providing independent storage for a volume is a carousel style storage for volumes. The import/export function may be provided by a port that allows operator access to one of the storage elements. In such a media changer a MOVE MEDIUM command to move a volume from a storage element to the import/export element rotates the carousel to align the addressed storage element to the import/export position. In this case, the import/export element does not provide independent storage but rather access to one of the storage elements.

Each element type shall be assigned a contiguous range of element addresses. The element address ranges assigned to element types shall not overlap. Element addresses are not required to form one contiguous range over all element types. Element address zero is reserved for use as the default medium transport element address.

5.2.2 Medium transport element

A medium transport element contains the functions of the media changer device that moves a volume from one element address to another. When a medium transport element may serve (even temporarily) as a storage location for a volume, each location where a volume may be held shall have a separate medium transport element address. Support for a medium transport element address being the source and/or destination address in a MOVE MEDIUM and EXCHANGE MEDIUM command is optional. The maximum number of medium transport elements is 127.

In larger media changer devices, the medium movement functions may be performed by multiple independent robotics subsystems. Each of these subsystems may have a number of medium transport element addresses. Sets of medium transport elements for the same common robotics system shall have their medium transport element addresses assigned contiguously.

Any of the medium transport element addresses within a media changer may be used in the MEDIUM TRANSPORT ELEMENT ADDRESS field of any MOVE MEDIUM, EXCHANGE MEDIUM, or POSITION TO ELEMENT command. An application client may determine the capabilities of the medium transport elements of a media changer via the Transport Geometry Parameters mode page.

Element address zero is reserved for use in the MEDIUM TRANSPORT ELEMENT ADDRESS field of the MOVE MEDIUM, EXCHANGE MEDIUM, and POSITION TO ELEMENT commands to direct the media changer to use either the default, or any available medium transport element. Support for element address zero is mandatory.

5.2.3 Storage element

Storage elements are locations of volumes while a volume is not in some other element type. A volume in a storage element is available for access by medium transport elements. If the device has no storage elements, then it shall have at least one import/export element with independent storage capability.

A storage element may be a source or destination address in a MOVE MEDIUM command or the optional EXCHANGE MEDIUM command.

5.2.4 Import/export element

Import/export elements are locations of volumes that are being inserted into or withdrawn from the media changer. A volume in one of these elements is accessible by at least one medium

transport element in the media changer, by the operator, or by another media changer device (i.e., interconnected media changer devices). Support for an import/export element is optional.

Any import/export element may be capable of import actions only, export actions only, or both.

The OPEN/CLOSE IMPORT/EXPORT ELEMENT command (see 6.7) may be used to open or close the import/export element. Whenever the OPEN/CLOSE IMPORT/EXPORT ELEMENT command causes a state change of the import/export element the device server shall establish a unit attention condition with the additional sense code set to IMPORT OR EXPORT ELEMENT ACCESSED for the initiator port associated with all I_T nexuses other than the I_T nexus on which the OPEN/CLOSE IMPORT/EXPORT ELEMENT command was received.

An import/export element address may be a source or destination address in a MOVE MEDIUM command or the optional EXCHANGE MEDIUM command. Import/export elements may or may not provide independent storage of a volume.

If the device server detects that one or more volumes have been inserted into or withdrawn from an import/export element by an operator, then the device server shall establish a unit attention condition for the initiator port associated with every I_T nexus and the additional sense code shall be set to IMPORT/EXPORT ELEMENT ACCESSED, MEDIUM CHANGED. The information field in the sense data shall report the import/export elements associated with the unit attention condition (see 5.2.8). The device server may establish a single unit attention condition for the initiator port associated with every I_T nexus when more than one volume has been inserted or withdrawn at the same time (e.g., upon closure of a structure containing multiple import/export elements).

5.2.5 Data transfer element

A data transfer element represents the interface between the media changer and a data transfer device (e.g., a removable media optical disk drive or tape drive). A data transfer element is considered part of the media changer and is not part of a data transfer device.

NOTE 2 — It should be possible to place a data transfer device of a compatible device class in proximity to a media changer, specify the interface as a data transfer element to the media changer, and begin operation without any change to the data transfer device. Closer coordination between the media changer and a data transfer device may be required in some implementations. Coordination may be implemented using ADC or a vendor specific-method.

Data transfer devices are capable of reading or writing the medium in a volume. Data transfer elements may also be viewed as media changer element addresses of volumes loaded in or available for loading in or removal from data transfer devices (e.g., disk or tape drives). Any data transfer element shall be accessible to at least one medium transport element.

A data transfer element address may be a source or destination address in a MOVE MEDIUM command or the optional EXCHANGE MEDIUM command. Data transfer elements may or may not provide independent storage of a unit of media, see the Device Capabilities mode page (7.3.2).

Data transfer devices may be removed from, replaced within, or added to the media changer at various times (e.g., when servicing a drive). These actions may affect the status of the data transfer element that interfaces with the data transfer device. Various unit attention conditions are established by the device server to notify application clients of these actions.

If replacement of a data transfer device does not change the values returned in the Element Address Assignment mode page (see 7.3.4) and the additional sense codes of DATA TRANSFER DEVICE REMOVED or DATA TRANSFER DEVICE INSERTED are used, then the device server shall:

1) disable the data transfer element (see 5.2.7) that interfaces with the data transfer device prior to removal of the data transfer device;
2) establish a unit attention condition for the initiator port associated with every I_T nexus with the additional sense code set to DATA TRANSFER DEVICE REMOVED upon removal of the data transfer device;
3) establish a unit attention condition for the initiator port associated with every I_T nexus with the additional sense code set to DATA TRANSFER DEVICE INSERTED upon insertion of the replacement data transfer device; and
4) enable the data transfer element (see 5.2.7) that interfaces with the data transfer device when the data transfer device is able to be returned to operation.

If removal of a data transfer device changes the values returned in the Element Address Assignment mode page (e.g., reduces the total number of data transfer elements) and the additional sense code of DATA TRANSFER DEVICE REMOVED is used, then the device server shall:

1) disable the data transfer element that interfaces with the data transfer device prior to removal of the data transfer device;
2) establish a unit attention condition for the initiator port associated with every I_T nexus with the additional sense code set to DATA TRANSFER DEVICE REMOVED upon removal of the data transfer device; and
3) establish a unit attention condition for the initiator port associated with every I_T nexus with the additional sense code set to MODE PARAMETERS CHANGED after updating the Element Address Assignment mode page.

If insertion of a data transfer device changes the values returned in the Element Address Assignment mode page (e.g., increases the total number of data transfer elements) and the additional sense code of DATA TRANSFER DEVICE INSERTED is used, then upon insertion of the data transfer device the device server shall:

1) establish a unit attention condition for the initiator port associated with every I_T nexus with the additional sense code set to DATA TRANSFER DEVICE INSERTED;
2) enable the data transfer element (see 5.2.7) that interfaces with the data transfer device when the data transfer device is able to be returned to operation; and
3) establish a unit attention condition for the initiator port associated with every I_T nexus with the additional sense code set to MODE PARAMETERS CHANGED after updating the Element Address Assignment mode page.

If the additional sense codes of DATA TRANSFER DEVICE REMOVED or DATA TRANSFER DEVICE INSERTED are used, then the INFORMATION field in the sense data shall contain the associated data transfer element address followed by a value of 0001h (see 5.2.8).

5.2.6 Element status maintenance requirements

The media changer determines element status data (see 6.11.2) during an inventory scan (see 3.1.14). The device server returns element status data upon successfully processing a READ ELEMENT STATUS command. The media changer should maintain the element status data between inventory scans. SCSI

commands may modify the element status data (e.g., EXCHANGE MEDIUM, MOVE MEDIUM, SEND VOLUME TAG).

SCSI commands that may cause the media changer to perform an inventory scan are:

a) an INITIALIZE ELEMENT STATUS command;
b) an INITIALIZE ELEMENT STATUS WITH RANGE command; and
c) a READ ELEMENT STATUS command with the CURDATA bit set to zero.

If the device server is unable to process a command due to invalid element status data, then the device server should terminate the command with CHECK CONDITION status and shall set the sense key to NOT READY and the additional sense code set to LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED.

5.2.7 Disabling/enabling elements

Elements within a media changer may be disabled at various times and later enabled. The element disabled (ED) bit (see 6.11.4) indicates that an element is either disabled (e.g., when a magazine has been removed or an element has been logically disabled for servicing) or enabled (e.g., when a magazine has been inserted or servicing of an element completes).

On transition from enabled to disabled, the device server shall establish a unit attention condition for the initiator port associated with every I_T nexus and the additional sense code shall be set to ELEMENT DISABLED. On transition from disabled to enabled, the device server shall establish a unit attention condition for the initiator port associated with every I_T nexus and the additional sense code shall be set to ELEMENT ENABLED. The INFORMATION field in the sense data shall report the disabled or enabled elements associated with the unit attention condition (see 5.2.8). The device server may establish a single unit attention condition for the initiator port associated with every I_T nexus when more than one element has been disabled or enabled at the same time.

5.2.8 Reporting elements in sense data

If the additional sense data reported requires one or more elements to be reported in the sense data (e.g., ELEMENT DISABLED), then the elements shall be reported as described in this subclause.

The INFORMATION field in the sense data (see SPC-4) shall contain the information specified in table 1.

Table 1 — INFORMATION field format

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)			FIRST ELEMENT ADDRESS				
1								(LSB)
2	(MSB)			NUMBER OF ELEMENTS				
3								(LSB)

The FIRST ELEMENT ADDRESS field contains the address of the first element associated with the reported sense data. The NUMBER OF ELEMENTS field contains the number of elements in the range inclusive of the first and last elements associated with the reported sense data (e.g., if there are five elements, and the second and fourth elements are associated with the reported sense data, then the FIRST ELEMENT ADDRESS field would contain the element address of the second element and the NUMBER OF ELEMENTS field would contain the value 0003h; the unassociated third element is included in the count of elements).

If only a single element is being reported, then the FIRST ELEMENT ADDRESS field contains the address of the element associated with the reported sense data and the NUMBER OF ELEMENTS field contains the value 0001h.

5.3 Volume tag information

5.3.1 Volume tag overview

The command response data of the READ ELEMENT STATUS command and the REQUEST VOLUME ELEMENT ADDRESS command include element descriptors that contain the VOLUME TAG INFORMATION field. This optional field is used to report volume identification information that the media changer acquired by any of the following methods:

a) reading an external label (e.g., bar code labels);
b) processing a SEND VOLUME TAG command with the assign or replace function;
c) reading MAM; or
d) by other means that may be vendor-specific.

The same volume tag information shall be available to all SCSI initiator ports regardless of whether the volume tag information was assigned by that SCSI initiator, by some other SCSI initiator, or by the media changer.

The VOLUME TAG INFORMATION field values may be independent of any volume identification information recorded on the medium or a volume.

This standard does not impose any requirement that volume tag information be unique for all volumes within a media changer. However the VOLUME SEQUENCE NUMBER field in the volume tag information may be used by the media changer to create uniqueness of the volume tag information.

If volume tag information is implemented, then the media changer shall retain the association between volume tag information and a volume as the volume is moved from element address to element address.

Volume tag information provides a means to confirm the identity of a volume that is stored at a media changer element address. When volume tag information is implemented, this standard does not specify any direct addressing of volumes based on the values in these fields. Optional commands are defined that provide translation between volume tag information and the element addresses.

The following commands support the optional volume tag functionality:

a) SEND VOLUME TAG – used to select volumes for the REQUEST VOLUME ELEMENT ADDRESS command, to associate new volume tag information with a volume, or to clear volume tag information for a volume;
b) REQUEST VOLUME ELEMENT ADDRESS – returns element status data of the volumes selected with the last successful SEND VOLUME TAG command. The element status data contain element descriptors that optionally report volume tag information; and
c) READ ELEMENT STATUS – returns element status data that contain element descriptors. The element descriptors optionally report volume tag information.

The SEND VOLUME TAG and the REQUEST VOLUME ELEMENT ADDRESS commands provide a means for the application client to translate volume tag information into element addresses. Application clients issue a SEND VOLUME TAG command with the send action code set to a

select function to specify search parameters about the requested volume tag information. Subsequent REQUEST VOLUME ELEMENT ADDRESS commands return descriptors for the selected volumes that match the previously specified volume tag information.

5.3.2 Volume tag assignments

Volume tag information may be assigned to a volume by means of the SEND VOLUME TAG command with the SEND ACTION CODE field set to an assert function or replace function.

Once assigned volume tag information shall not be affected by the following:

a) INITIALIZE ELEMENT STATUS command;
b) INITIALIZE ELEMENT STATUS WITH RANGE command;
c) READ ELEMENT STATUS command; and
d) logical unit resets.

Assigned volume tag information shall be cleared when:

a) when it is undefined by the SEND VOLUME TAG command with the undefine function; and
b) when the volume is removed from the media changer.

Assigned volume tag information may be cleared on a hard reset.

5.3.3 Primary and alternate volume tag information

Element status descriptors, as optionally reported by the READ ELEMENT STATUS command, permit defining a primary volume tag and an alternate volume tag. Alternate volume tag information provides a means for a system to use different volume tag information for each side of a volume. Primary volume tag information refers to the logical medium accessible via a MOVE MEDIUM or EXCHANGE MEDIUM command with the INVERT bit set to zero. Alternate volume tag information refers to the other side of the media (i.e., the side that would be accessed via a MOVE MEDIUM or EXCHANGE MEDIUM command with the INVERT bit set to one). Some volumes may be recorded on both sides. The INVERT bit permits an aplication client to rotate a volume.

All volumes shall have a primary volume tag information attribute.

5.3.4 Volume tag information format

Volume tag information consists of a volume identifier, volume identifier qualifier, and volume sequence number.

Table 2 defines the fields within the primary and alternate volume tag information fields that may be present in READ ELEMENT STATUS descriptors and in the data format for the SEND VOLUME TAG command.

Table 2 — Volume tag information format

Bit / Byte	7	6	5	4	3	2	1	0
0	VOLUME IDENTIFIER							
31								
32	VIQ							
33	Reserved							

34	(MSB)	VOLUME SEQUENCE NUMBER	
35			(LSB)

The VOLUME IDENTIFIER field shall contain the volume identifier for the medium. The volume identifier consist of a left justified sequence of characters. Unused positions shall be blank (20h) filled. In order for the SEND VOLUME TAG translate with template to work, the characters '*' and '?' (2Ah and 3Fh) shall not appear in the VOLUME IDENTIFIER field and there shall be no blanks (20h) in the significant part (non blank filled) of the VOLUME IDENTIFIER field. If the volume identifier for a particular element cannot be determined, then the VOLUME IDENTIFIER field shall be filled with 00h.

NOTE 3 — For compatibility with existing volume label conventions, it is recommended that the characters in the significant non-blank portion of the VOLUME IDENTIFIER field be restricted to the set: '0'…'9', 'A'…'Z'' and '_'.

The Volume Identifier Qualifier (VIQ) field provides additional information as defined by table 3.

Table 3 — Volume Identifier Qualifier

Code	Description
0h	This value shall be returned when the volume identifier has been determined or the media changer does not contain a volume tag reader (see Device Capabilities mode page description).
1h	The volume identifier is currently inaccessible (e.g. medium is loaded in a data transfer element such that a barcode label can not be accessed and there is no prior knowledge of the label).
2h	The volume identifier is unreadable or there is a problem with the volume tag reader.
3h – FFh	Reserved

The optional VOLUME SEQUENCE NUMBER field returns a unique number for every volume in the media changer. If the media changer does not support the VOLUME SEQUENCE NUMBER field, then this field shall be set to zero.

If used, then the value in the VOLUME SEQUENCE NUMBER field should be unique for every volume and in combination with the VOLUME IDENTIFIER shall be unique for every volume.

NOTE 4 — Application clients may use the value returned in the VOLUME SEQUENCE NUMBER field to distinguish between volumes having the same value in the VOLUME IDENTIFIER field.

5.4 Volume types overview

Each element in a media changer is capable of accepting at least one volume type. A volume type and volume qualifier combination describes a volume supported by an element. If the REPORT SUPPORTED VOLUME TYPES command is supported, then the device server shall define volume types and volume qualifiers. The volume types should be the same for all volumes that have the same form factor (see 3.1.12). The volume types should not be the same for volumes that have different form factors. The volume type codes are defined in table 4.

Table 4 — Volume type codes

Code	Description
00h	Reserved
01h – 7Fh	Vendor-specific

80h – FFh	Reserved

The volume qualifier describes additional characteristics of the volume. The volume qualifier codes are defined in table 5.

Table 5 — Volume qualifier codes

Code	Description
00h	All Qualifiers
01h – 7Fh	Vendor-specific
80h – FFh	Reserved

The REPORT VOLUME TYPES SUPPORTED command (see 6.13) allows the application client to retrieve the set of valid volume type and volume qualifier combinations.

If an application client requests to move a volume to an element that is incompatible with this volume type, then the device server shall terminate the command with CHECK CONDITION status, the sense key shall be set to ILLEGAL REQUEST and the sense data shall be set to INCOMPATIBLE VOLUME TYPE.

If an application client requests to move a volume to a data transfer element that has a compatible volume type and an incompatible volume qualifier, then the device server shall terminate the command with CHECK CONDITION status, the sense key shall be set to ILLEGAL REQUEST and the sense data shall be set to INCOMPATIBLE VOLUME QUALIFIER.

5.5 TapeAlert information

5.5.1 TapeAlert introduction

TapeAlert information is accessed using the TapeAlert log page (see 7.2.2) and configuration is performed using the Informational Exceptions Control mode page (see SPC-3). The MODE SENSE and MODE SELECT configuration of the TapeAlert interface is compatible with the Informational Exceptions Control mode page. The application client should first check the media changer to determine whether it supports the TapeAlert log page. The default application client access to the TapeAlert log page is performed using a polling method, with the page control bits in the LOG SENSE command set to 00h. The TapeAlert log page may be read at any time and should be read from the media changer device following an error.

The application client may also poll the TapeAlert log page at regular intervals (e.g., every 60 seconds) while the media changer is idle. The application client may use the Information Exceptions Control mode page to configure other access methods, depending on what options are supported by the media changer.

Each time the application client reads the TapeAlert log page, it should check all 64 flags (see Table A.1) to discover which flags are active (there may be more than one). The definitions of the 64 flags are device type specific. For each flag active, the application client should communicate the defined error message and severity for that flag to the user and log it. If multiple flags are active simultaneously, then they should be displayed together in ascending order of severity. At the beginning of each set of TapeAlert error messages, the device that initiated them should be identified.

5.5.2 TapeAlert log sense format

The TapeAlert interface to the media changer is based on a LOG SENSE page (see 7.2.2) containing 64 one-byte flags (see table A.1). The specific conditions for any specific flag to be active and inactive are vendor-specific.

The TapeAlert data is event based and the page control bits in the LOG SENSE command are not applicable and shall be ignored by the device server.

All flags shall be deactivated in the following circumstances:

a) after the TapeAlert log page is read. The TapeAlert flags shall be deactivated on a per-initiator basis such that active flags are available for other initiators;
b) when the specified corrective action has been taken (e.g., closing the door);
c) on logical unit reset; or
d) when the PCR field in the LOG SELECT command descriptor block is one (see SPC-3).

If a LOG SELECT command is enabled for the TapeAlert log page, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

When a flag is deactivated by reading the TapeAlert log page, a flag shall not be active again until the error condition is removed (i.e., the specified corrective action has been taken). For example, if the media changer door is open, once flag 10h has been deactivated by the application client reading the log page, it shall not be activated again until the door is closed. All other methods of deactivating the flag allow the flag to be activated again.

5.6 Capability-based command security

5.6.1 Capability-based command security (CbCS) overview

CbCS is a credential-based system that manages access to a logical unit or a volume. See SPC-4.

5.6.2 Association between commands and permission bits

The following commands shall, if implemented, be processed by the secure CDB processor without requiring CbCS extension (see SPC-4):

a) REPORT VOLUME TYPES SUPPORTED command; and
b) REQUEST DATA TRANSFER ELEMENT INQUIRY command.

Table 6 defines the permissions required in the PERMISSIONS BIT MASK field in the CAPABILITY descriptor of a CbCS extension descriptor (see SPC-4) for each SCSI command defined in this standard that requires CbCS extension.

Table 6 — Associations between commands and CbCS permissions

Requested command	Permissions		
	PHY ACC	ACC MCHGR	ACC MEDIUM
EXCHANGE MEDIUM		V	V
INITIALIZE ELEMENT STATUS		V	

INITIALIZE ELEMENT STATUS WITH RANGE		V	
MOVE MEDIUM		V	V
OPEN/CLOSE IMPORT/EXPORT ELEMENT	V		
POSITION TO ELEMENT		V	
PREVENT ALLOW MEDIUM REMOVAL	V		
READ ELEMENT STATUS		V	
REQUEST VOLUME ELEMENT ADDRESS		V	
SEND VOLUME TAG		V	
For each cell in marked with 'V', the secure CDB processor shall process the requested command only if the corresponding bit is set in the PERMISSIONS BIT MASK field in the CAPABILITY descriptor of a CbCS extension descriptor			

5.6.3 The PERMISSION BIT MASK descriptor field in CbCS Capability

The CbCS capability format is defined in SPC-4. The PERMISSIONS BIT MASK descriptor (see Table 7) specifies the permissions allowed by this CbCS capability. More than one permissions bit may be set. The secure CDB processor shall verify that the bits applicable to the encapsulated command are all set to one in the PERMISSIONS BIT MASK descriptor before performing the encapsulated SCSI command.

The association of permissions to commands is defined in 5.6.2 for commands defined in this standard. Associations for other commands are defined in the specific command standards.

In Table 7 byte 0, byte 1 and byte 2 specify the command functions for all SCSI commands (see SPC-4). In Table 7 byte 3 is used by this command standard to specify permissions. The associations between the command functions specified in the permissions bit mask descriptor and SCSI commands defined in this standard are specified in 5.6.2.

Table 7 — PERMISSIONS BIT MASK descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Defined in SPC-4							
2								
3	ACC MCHGR	ACC MEDIUM	Reserved					

An ACC MCHGR bit set to zero indicates the encapsulated SCSI command has no permission to access element status data or robotic motion. An ACC MCHGR bit set to one indicates the encapsulated SCSI command has permission to access element status data and robotic motion.

An ACC MEDIUM bit set to zero indicates the encapsulated SCSI command has no permission to access the medium. An ACC MEDIUM bit set to one indicates the encapsulated SCSI command has permission to access the medium.

6 Commands for media changer devices

6.1 Summary of commands for media changers

The commands for media changer devices shall be as shown in table 8. The following operation codes are obsolete: A7h (i.e., MOVE MEDIUM ATTACHED) and B4h (i.e., READ ELEMENT STATUS ATTACHED).

Table 8 — Commands for media changer devices (part 1 of 2)

Command name	Operation Code	Type	Reference
ACCESS CONTROL IN	86h	O	SPC-3
ACCESS CONTROL OUT	87h	O	SPC-3
CHANGE ALIASES	A4h/0Bh [a]	O	SPC-3
EXCHANGE MEDIUM	A6h	O	6.3
INITIALIZE ELEMENT STATUS	07h	M	6.4
INITIALIZE ELEMENT STATUS WITH RANGE	37h	O	6.5
INQUIRY	12h	M	SPC-3
LOG SELECT	4Ch	O	SPC-3
LOG SENSE	4Dh	O	SPC-3
MAINTENANCE IN	A3h/00h – 04h [a] A3h/06h – 09h [a]	X [c]	SCC-2
MAINTENANCE OUT	A4h/00h – 05h [a] A4h/07h – 09h [a]	X [c]	SCC-2
MODE SELECT (6)	15h	O	SPC-3
MODE SELECT (10)	55h	O	SPC-3
MODE SENSE (6)	1Ah	O	SPC-3
MODE SENSE (10)	5Ah	O	SPC-3
MOVE MEDIUM	A5h	M	6.6
OPEN/CLOSE IMPORT/EXPORT ELEMENT	1Bh	O	6.7
PERSISTENT RESERVE IN	5Eh	O	SPC-3
PERSISTENT RESERVE OUT	5Fh	O	SPC-3
POSITION TO ELEMENT	2Bh	O	6.8
PREVENT ALLOW MEDIUM REMOVAL	1Eh	O	6.9
READ ATTRIBUTE	8Ch	O	6.10
READ BUFFER	3Ch	O	SPC-3
READ ELEMENT STATUS	B8h	M	6.11
RECEIVE DIAGNOSTIC RESULTS	1Ch	O/M [b]	SPC-3
REDUNDANCY GROUP IN	BAh	X [c]	SCC-2
REDUNDANCY GROUP OUT	BBh	X [c]	SCC-2
RELEASE (6)	17h	O	SPC-2
RELEASE (10)	57h	O	SPC-2
REPORT ALIASES	A3h/0Bh [a]	O	SPC-3

Key: M = command implementation is mandatory.
O = command implementation is optional.

[a] This command is defined by a combination of operation code and service action. The operation code value is shown preceding the slash and the service action value is shown after the slash.

[b] If the ENCSERV bit is set to one in the standard INQUIRY data (see SPC-3), the device server shall support this command. If the ENCSERV bit is set to zero, the device server may support this command.

[c] If the SCCS bit is set to one in the standard INQUIRY data (see SPC-3), SCC-2 specifies the requirements for the device server supporting this command. If the SCCS bit is set to zero, the device server shall not support this command.

Table 8 — Commands for media changer devices (part 2 of 2)

Command name	Operation Code	Type	Reference
REPORT DEVICE IDENTIFIER	A3h/05h [a]	O	SPC-3
REPORT LUNS	A0h	M	SPC-3
REPORT PRIORITY	A3h/0Eh [a]	O	SPC-3
REPORT SUPPORTED OPERATION CODES	A3h/0Ch [a]	O	SPC-3
REPORT SUPPORTED TASK MANAGEMENT FUNCTIONS	A3h/0Dh [a]	O	SPC-3
REPORT TARGET PORT GROUPS	A3h/0Ah [a]	O	SPC-3
REPORT TIMESTAMP	A3h/0Fh [a]	O	SPC-3
REPORT VOLUME TYPES SUPPORTED	44h	O	6.13
REQUEST DATA TRANSFER ELEMENT INQUIRY	A3h/06h [a]	O	6.12
REQUEST VOLUME ELEMENT ADDRESS	B5h	O	6.14
REQUEST SENSE	03h	M	SPC-3
RESERVE (6)	16h	O	SPC-2
RESERVE (10)	56h	O	SPC-2
SEND DIAGNOSTIC	1Dh	M	SPC-3
SEND VOLUME TAG	B6h	O	6.15
SET DEVICE IDENTIFIER	A4h/06h [a]	O	SPC-3
SET PRIORITY	A4h/0Eh [a]	O	SPC-3
SET TARGET PORT GROUPS	A4h/0Ah [a]	O	SPC-3
SET TIMESTAMP	A4h/0Fh [a]	O	SPC-3
SPARE IN	BCh	X [c]	SCC-2
SPARE OUT	BDh	X [c]	SCC-2
TEST UNIT READY	00h	M	SPC-3
VOLUME SET IN	BEh	X [c]	SCC-2
VOLUME SET OUT	BFh	X [c]	SCC-2
WRITE ATTRIBUTE	8Dh	O	6.16
WRITE BUFFER	3Bh	O	SPC-3

Key: M = command implementation is mandatory.
O = command implementation is optional.

[a] This command is defined by a combination of operation code and service action. The operation code value is shown preceding the slash and the service action value is shown after the slash.

[b] If the ENCSERV bit is set to one in the standard INQUIRY data (see SPC-3), the device server shall support this command. If the ENCSERV bit is set to zero, the device server may support this command.

[c] If the SCCS bit is set to one in the standard INQUIRY data (see SPC-3), SCC-2 specifies the requirements for the device server supporting this command. If the SCCS bit is set to zero, the device server shall not support this command.

6.2 Commands allowed in the presence of various reservations

Reservation restrictions are placed on commands as a result of access qualifiers associated with the type of reservation.

The details of which SMC commands are allowed under what types of reservations are described in table 9. For the reservation restrictions placed on commands for the reserve/release management method, see table 9 column [A]. For the reservation restrictions placed on commands for the persistent reservations management method, see the columns under [B] in table 9. Reservation restrictions of commands defined by SPC-2 are described in SPC-2.

In table 9 the following key words are used:

Allowed: Commands received from SCSI initiators not holding the reservation or from SCSI initiator ports not registered when a registrants only or all registrants persistent reservation is present should complete normally.

Conflict: Commands issued by received from SCSI initiators not holding the reservation or from SCSI initiator ports not registered when a registrants only or all registrants persistent reservation is present shall not be performed and the device server shall terminate the command with a RESERVATION CONFLICT status.

Commands from SCSI initiator ports holding a reservation should complete normally. The behavior of commands from registered SCSI initiator ports when a registrants only or all registrants persistent reservation is present is specified in table 9.

An unlinked command shall be checked for reservation conflicts before the task containing that command enters the enabled task state. The reservation state as it exists when the first command in a group of linked commands enters the enabled task state shall be used in checking for reservation conflicts for all commands in the task. Once a task has entered the enabled task state, the command or commands comprising that task shall not be terminated with a RESERVATION CONFLICT due to a subsequent reservation. Any command in a group of linked commands that changes the reservation state shall be the last command in the group.

For each command, this standard, SPC-2, or a related command standard defines the conditions that result in RESERVATION CONFLICT. Depending on the particular command standard the conditions are defined in that standard's device model clause or in the subclauses that define the specific commands. An annex in SPC-2 contains the RESERVATION CONFLICT information for some of the command sets.

Table 9 — SMC commands allowed in the presence of various reservations

Command	Addressed LU is reserved by another initiator [A]	Addressed LU has this type of persistent reservation held by another initiator [B]				
		From any initiator		From registered initiator (RR all types)	From any initiator not registered	
		Write Excl	Excl Access		Write Excl - RR	Excl Access - RR
EXCHANGE MEDIUM	Conflict	Conflict	Conflict	Allowed	Conflict	Conflict
INITIALIZE ELEMENT STATUS	Conflict	Conflict	Conflict	Allowed	Conflict	Conflict
INITIALIZE ELEMENT STATUS WITH RANGE	Conflict	Conflict	Conflict	Allowed	Conflict	Conflict
MOVE MEDIUM	Conflict	Conflict	Conflict	Allowed	Conflict	Conflict
POSITION TO ELEMENT	Conflict	Conflict	Conflict	Allowed	Conflict	Conflict
PREVENT ALLOW MEDIUM REMOVAL (PREVENT = 00b)	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed
PREVENT ALLOW MEDIUM REMOVAL (PREVENT = 01b)	Conflict	Conflict	Conflict	Allowed	Conflict	Conflict
OPEN/CLOSE IMPORT/EXPORT ELEMENT	Conflict	Conflict	Conflict	Allowed	Conflict	Conflict
READ ATTRIBUTE	See SPC-3					
READ ELEMENT STATUS (CURDATA = 0)	Conflict	Conflict	Conflict	Allowed	Conflict	Conflict
READ ELEMENT STATUS (CURDATA = 1)	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed
REPORT VOLUME TYPES SUPPORTED	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed
REQUEST DATA TRANSFER ELEMENT INQUIRY	Allowed	Allowed	Allowed	Allowed	Allowed	Allowed
REQUEST VOLUME ELEMENT ADDRESS	Conflict	Conflict	Conflict	Allowed	Conflict	Conflict
SEND VOLUME TAG	Conflict	Conflict	Conflict	Allowed	Conflict	Conflict
WRITE ATTRIBUTE	Conflict	Conflict	Conflict	Allowed	Conflict	Conflict
Key: LU=Logical Unit, Excl=Exclusive, RR=Registrants Only or All Registrants						

6.3 EXCHANGE MEDIUM command

The EXCHANGE MEDIUM command (see table 10) provides a means to replace the volume at an element address with another volume. Support of this command requires that the logical unit has the capability of handling two volumes at the same time or that it emulate this capability.

Table 10 — EXCHANGE MEDIUM command

Bit / Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A6h)							
1	Reserved							
2	(MSB)			MEDIUM TRANSPORT ADDRESS				
3								(LSB)
4	(MSB)			SOURCE ADDRESS				
5								(LSB)
6	(MSB)			FIRST DESTINATION ADDRESS				
7								(LSB)
8	(MSB)			SECOND DESTINATION ADDRESS				
9								(LSB)
10	Reserved						INV1	INV2
11	CONTROL							

The volume in the SOURCE ADDRESS element is moved to the FIRST DESTINATION ADDRESS element and the volume that previously occupied the FIRST DESTINATION ADDRESS element is moved to the SECOND DESTINATION ADDRESS element. The SECOND DESTINATION ADDRESS element may or may not be the same as the SOURCE ADDRESS element. In the case of a simple exchange, SOURCE ADDRESS and SECOND DESTINATION ADDRESS are the same. The Device Capabilities mode page (see 7.3.2) provides a matrix that defines the supported source element type and first destination element type combinations for EXCHANGE MEDIUM commands when the source element type is the same as second destination element type.

If the SOURCE ADDRESS element is empty, or the FIRST DESTINATION ADDRESS element is empty, then the command shall be terminated with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to MEDIUM SOURCE ELEMENT EMPTY. If the SECOND DESTINATION ADDRESS element is full, and not the same as the SOURCE ADDRESS element, then the command shall be terminated with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to MEDIUM DESTINATION ELEMENT FULL.

The MEDIUM TRANSPORT ADDRESS field specifies the medium transport element that is to be used in executing this command. The default transport element address of zero may be used. If the MEDIUM TRANSPORT ADDRESS element has not been assigned or that element address has been assigned to a different element type, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID ELEMENT ADDRESS.

The SOURCE ADDRESS field, the FIRST DESTINATION ADDRESS field, and the SECOND DESTINATION ADDRESS field may represent a storage element, an import/export element, a data transfer

element, or a medium transport element. If an address specified has not been assigned to a specific element of the media changer, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID ELEMENT ADDRESS.

When processing an EXCHANGE MEDIUM command, the device server shall terminate the command with CHECK CONDITION status and shall set the sense key to ILLEGAL REQUEST and the additional sense code to MEDIUM REMOVAL PREVENTED BY DATA TRANSFER ELEMENT if:

a. the element address specified in the SOURCE ADDRESS field or the FIRST DESTINATION ADDRESS field represents a data transfer element;
b. the device server detects a prevention of medium removal condition exists within the data transfer device (see applicable command standard); and
c. the device server does not allow moves from an element associated with a data transfer device that has a prevent medium removal condition.

When processing an EXCHANGE MEDIUM command, the device server shall terminate the command with CHECK CONDITION status and shall set the sense key to ILLEGAL REQUEST and the additional sense code to MEDIUM REMOVAL PREVENTED if:

a. the element address specified in the FIRST DESTINATION ADDRESS field or the SECOND DESTINATION ADDRESS field represents an import/export element;
b. a prevention of medium removal condition exists within the medium changer; and
c. the MVPRV bit in the Extended Device Capabilities mode page (see 7.3.3) is set to one.

An INV1 bit set to one specifies that the volume shall be inverted prior to depositing the volume into the FIRST DESTINATION ADDRESS element. Support for this bit set to one is optional.

An INV2 bit set to one specifies that the volume shall be inverted prior to depositing the volume into the SECOND DESTINATION ADDRESS element. Support for this bit set to one is optional.

See SAM-3 for a description of the CONTROL byte.

If the media changer does not support volume rotation for handling double sided volumes, then the INV1 and INV2 bits should be set to zero. If either of these bits is set to one, then a device server that is not capable of volume rotation shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

See 5.4 for how the volume type and volume qualifier affect the processing of the EXCHANGE MEDIUM command.

6.4 INITIALIZE ELEMENT STATUS command

The INITIALIZE ELEMENT STATUS command (see table 11) shall cause the media changer to validate the inventory. The intent of this command is to enable the application client to get a quick response from a subsequent READ ELEMENT STATUS command. It may be useful to issue this command after a power failure, or if a volume has been changed by an operator, or if configurations have been changed. The device server shall not return GOOD status for this command until the inventory validation is complete. If the element status data is valid, then the device server may return GOOD status for this command without performing an inventory scan.

Table 11 — INITIALIZE ELEMENT STATUS command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (07h)							
1	Reserved							
2	Reserved							
3	Reserved							
4	Reserved							
5	CONTROL							

See SAM-3 for a description of the CONTROL byte.

If an implementation does not support this command, then the same function is provided in the READ ELEMENT STATUS command.

6.5 INITIALIZE ELEMENT STATUS WITH RANGE command

The INITIALIZE ELEMENT STATUS WITH RANGE command (see table 12) shall cause the media changer to validate the inventory for the specified element range. The intent of this command is to enable the application client to get a quick response from a subsequent READ ELEMENT STATUS command. It may be useful to issue this command after a power failure, if a volume has been changed by an operator, or if configurations have been changed. The device server shall not return GOOD status for this command until the inventory validation is complete. If the element status data is valid, then the device server may return GOOD status for this command without performing an inventory scan.

Table 12 — INITIALIZE ELEMENT STATUS WITH RANGE command

Bit / Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (37h)							
1	Reserved						FAST	RANGE
2	(MSB)	STARTING ELEMENT ADDRESS						
3								(LSB)
4	Reserved							
5	Reserved							
6	(MSB)	NUMBER OF ELEMENTS						
7								(LSB)
8	Reserved							
9	CONTROL							

A RANGE bit set to zero specifies that all element addresses shall be checked and that the NUMBER OF ELEMENTS field and STARTING ELEMENT ADDRESS field are ignored. A RANGE bit set to one specifies that the series of elements beginning at the STARTING ELEMENT ADDRESS field for the specified number of elements shall be checked. If the NUMBER OF ELEMENTS field is set to zero, the range checked shall start with the starting element address and continue through the last element address on the unit.

A FAST bit set to one indicates that the specified elements shall be scanned for media presence only. A FAST bit set to zero indicates that the specified elements shall be scanned for all relevant status.

See SAM-3 for a description of the CONTROL byte.

NOTE 5 — Prior to standardization, many media changers implemented this command using a vendor specific OPERATION CODE of E7h.

6.6 MOVE MEDIUM command

The MOVE MEDIUM command (see table 13) request that the device server move a volume from a source element to a destination element.

Table 13 — MOVE MEDIUM command

Bit / Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A5h)							
1	Reserved							
2	(MSB)			MEDIUM TRANSPORT ADDRESS				
3								(LSB)
4	(MSB)			SOURCE ADDRESS				
5								(LSB)
6	(MSB)			DESTINATION ADDRESS				
7								(LSB)
8	Reserved							
9	Reserved							
10	Reserved							INVERT
11	CONTROL							

This command moves the volume from the element specified by SOURCE ADDRESS field to the element specified by DESTINATION ADDRESS field.

If the SOURCE ADDRESS element is empty, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to MEDIUM SOURCE ELEMENT EMPTY. If the DESTINATION ADDRESS element is full, and different from the SOURCE ADDRESS element, then the device server target shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to MEDIUM DESTINATION ELEMENT FULL.

The MEDIUM TRANSPORT ADDRESS field specifies the medium transport element that is to be used in executing this command. If the address specified has not been assigned or has been assigned to an element other than a medium transport element, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID ELEMENT ADDRESS.

The SOURCE ADDRESS field and the DESTINATION ADDRESS field may represent a storage element, an import/export element, a data transfer element, or a medium transport element. If the address specified has not been assigned to a specific element of the media changer, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID ELEMENT ADDRESS.

When processing a MOVE MEDIUM command, the device server shall terminate the command with CHECK CONDITION status and shall set the sense key to ILLEGAL REQUEST and the additional sense code to MEDIUM REMOVAL PREVENTED BY DATA TRANSFER ELEMENT if:

a. the element address specified in the SOURCE ADDRESS field represents a data transfer element;
b. the device server detects a prevention of medium removal condition exists within the data transfer device (see applicable command standard); and
c. the device server does not allow moves from an element associated with a data transfer device that has a prevent medium removal condition.

When processing a MOVE MEDIUM command, the device server shall terminate the command with CHECK CONDITION status and shall set the sense key to ILLEGAL REQUEST and the additional sense code to MEDIUM REMOVAL PREVENTED if:

a. the element address specified in the DESTINATION ADDRESS field represents an import/export element;
b. a prevention of medium removal condition exist within the media changer; and
c. the MVPRV bit in the Extended Device Capabilities mode page (see 7.3.3) is set to one.

The Device Capabilities mode page (see 7.3.2), provides a matrix with the supported source element or destination element combinations for the MOVE MEDIUM command.

An INVERT bit set to one specifies that the volume shall be inverted or rotated prior to depositing the medium into the DESTINATION ADDRESS element. If the media changer does not support volume rotation for handling double sided media, then the INVERT bit should be set to zero. If this bit is set to one, a device server that is not capable of volume rotation shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

See SAM-3 for a description of the CONTROL byte.

See 5.4 for how the volume type and volume qualifier affect the processing of the MOVE MEDIUM command.

6.7 OPEN/CLOSE IMPORT/EXPORT ELEMENT command

The OPEN/CLOSE IMPORT/EXPORT ELEMENT command (see table 14) provides a method for the application client to change the open/closed state of the specified import/export element. The ELEMENT ADDRESS field specifies the import/export element address and the ACTION CODE field specifies the requested action to the device server.

This command has no command parameter data. No command response data is returned.

Table 14 — OPEN/CLOSE IMPORT/EXPORT ELEMENT command

Bit / Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (1BH)							
1	Reserved							
2	(MSB)	ELEMENT ADDRESS						
3								(LSB)
4	Reserved			ACTION CODE				
5	CONTROL							

The action codes defined for the OPEN/CLOSE IMPORT/EXPORT ELEMENT command are shown in table 15. If the value in the ACTION CODE field is not supported, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

Table 15 — OPEN/CLOSE IMPORT/EXPORT ELEMENT action codes

Action Code	Description
0h	OPEN IMPORT/EXPORT ELEMENT
1h	CLOSE IMPORT/EXPORT ELEMENT
2h – Fh	Reserved

An OPEN/CLOSE IMPORT/EXPORT ELEMENT command with OPEN IMPORT/EXPORT ELEMENT action code shall cause the media changer to open the import/export element for operator access with the element address specified in the ELEMENT ADDRESS field. It is not considered an error when the import/export element was already open.

An OPEN/CLOSE IMPORT/EXPORT ELEMENT command with CLOSE IMPORT/EXPORT ELEMENT action code shall cause the media changer to close the import/export element for operator access with the element address specified in the ELEMENT ADDRESS field. It is not considered an error when the import/export element was already closed.

If a prevention of medium removal condition exist within the media changer and the ACTION CODE field is set to OPEN IMPORT/EXPORT ELEMENT, then the device server may terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to MEDIUM REMOVAL PREVENTED.

If the address specified in the ELEMENT ADDRESS field has not been assigned or has been assigned to an element type other than import/export element, then the device server shall terminate the command with

CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID ELEMENT ADDRESS.

See SAM-3 for a description of the CONTROL byte.

After a state change of the import/export element the device server shall establish a unit attention condition with the additional sense code set to IMPORT OR EXPORT ELEMENT ACCESSED for the initiator port associated with all I_T nexuses other than the I_T nexus on which the OPEN/CLOSE IMPORT EXPORT ELEMENT command was received.

6.8 POSITION TO ELEMENT command

The POSITION TO ELEMENT command (see table 16) requests the device server to position the medium transport element to a specified element address.

Table 16 — POSITION TO ELEMENT command

Bit / Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (2Bh)							
1	Reserved							
2	(MSB)			MEDIUM TRANSPORT ADDRESS				
3								(LSB)
4	(MSB)			DESTINATION ADDRESS				
5								(LSB)
6	Reserved							
7	Reserved							
8	Reserved							INVERT
9	CONTROL							

The MEDIUM TRANSPORT ADDRESS field specifies the medium transport element used in the processing of this command. The default medium transport element address of zero may be used. If the element address specified in the MEDIUM TRANSPORT ADDRESS field has not been assigned or has been assigned to a different element type, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID ELEMENT ADDRESS.

The element specified by the DESTINATION ADDRESS field may represent a storage element, an import/export element, a data transfer element, or a medium transport element. If the element address specified by the DESTINATION ADDRESS field has not been assigned, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID ELEMENT ADDRESS.

An INVERT bit set to one specifies that the medium transport element be inverted or rotated prior to positioning at the DESTINATION ADDRESS element. If the media changer does not support volume rotation for handling double-sided media, then the INVERT bit should be set to zero. If this bit is set to one, then a device server that is not capable of volume rotation shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

See SAM-3 for a description of the CONTROL byte.

NOTE 6 — See PEPOS bit in 7.3.3

6.9 PREVENT ALLOW MEDIUM REMOVAL command

The PREVENT ALLOW MEDIUM REMOVAL command (see table 17) requests that the media changer logical unit prevents or allows removal of media from the media changer. The logical unit shall not allow medium removal if any initiator port currently has medium removal prevented.

Table 17 — PREVENT ALLOW MEDIUM REMOVAL command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (1Eh)							
1	Reserved							
6	Reserved							
7	Reserved							
8	Reserved							PREVENT
9	CONTROL							

Table 18 specifies the PREVENT field values and their meanings.

Table 18 — PREVENT field

Prevent	Description
00b	Medium removal shall be allowed
01b	Medium removal shall be prevented
10b	Obsolete
11b	Obsolete

A prevention of medium removal condition shall begin on successful completion of a PREVENT ALLOW MEDIUM REMOVAL command with the PREVENT field set to 01b from at least one I T nexus (i.e., medium removal prevented). The prevention of medium removal condition for the logical unit shall terminate after:

a) one of the following occurs for each I_T nexus that had previously prevented medium removal:
   A) successful completion of a PREVENT ALLOW MEDIUM REMOVAL command with the PREVENT field set to 00b; or
   B) an I_T nexus loss.
b) a power on;
c) a hard reset; or
d) a logical unit reset.

If a persistent reservation or registration is being preempted by a PERSISTENT RESERVE OUT command with PREEMPT AND ABORT service action (see SPC-3), the equivalent of a PREVENT ALLOW MEDIUM REMOVAL command with the PREVENT field set to 00b shall be processed for each I_T nexus associated with the persistent reservation or registrations being preempted. This allows an application client to override the prevention of medium removal condition for an initiator port that is no longer operating correctly.

A device that supports the PREVENT ALLOW MEDIUM REMOVAL command shall set to one in the Extended Device Capabilities mode page (see 7.3.3) at least one of:

a) MVPRV bit;
b) LCKD bit; or
c) LCKIE bit.

While a prevention of medium removal condition is in effect the media changer logical unit shall follow the behavior defined by the settings of the MVPRV bit, LCKD bit, and LCKIE bit in the Extended Device Capabilities mode page.

6.10 READ ATTRIBUTE command

6.10.1 READ ATTRIBUTE command introduction

The READ ATTRIBUTE command (see table 19) allows an application client to read attribute values from the medium auxiliary memory (MAM) of the volume selected by the value in the ELEMENT ADDRESS field and also to discover which elements contain a volume with MAM.

Table 19 — READ ATTRIBUTE command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (8Ch)							
1	Reserved			SERVICE ACTION				
2	(MSB)			ELEMENT ADDRESS				
3								(LSB)
4	Reserved				ELEMENT TYPE CODE			
5	VOLUME NUMBER							
6	Reserved							
7	PARTITION NUMBER							
8	(MSB)			FIRST ATTRIBUTE IDENTIFIER				
9								(LSB)
10	(MSB)			ALLOCATION LENGTH				
11								
12								
13								(LSB)
14	Reserved							
15	CONTROL							

The service action codes defined for the READ ATTRIBUTE command are shown in table 20. If the value in the SERVICE ACTION field is not supported then the device server shall return CHECK CONDITION status. The sense key shall be ILLEGAL REQUEST and the sense data shall be set to INVALID FIELD IN CDB.

Table 20 — READ ATTRIBUTE service action codes

Code	Name	Description	Reference
00h	ATTRIBUTE VALUES	Return attribute values	SPC-3
01h	ATTRIBUTE LIST	Return a list of available attribute identifiers, identifiers that are not in the nonexistent state or unsupported state (see SPC-3)	SPC-3
02h	VOLUME LIST	Return a list of known volume numbers	SPC-3
03h	PARTITION LIST	Return a list of known partition numbers	SPC-3
04h	ELEMENT LIST	Return a list of elements containing volumes with MAM	6.10.2
05h-1Fh	Reserved		

If the SERVICE ACTION field is set to ELEMENT LIST, then the ELEMENT ADDRESS field specifies the lowest element address to report. Only elements with a volume that contains MAM, and with an element type code specified by the ELEMENT TYPE CODE field (see table 24), and an element address greater than or equal to the value specified in the ELEMENT ADDRESS field shall be reported (see 6.10.2).

If the SERVICE ACTION field is set to a value other than ELEMENT LIST, then the ELEMENT ADDRESS field specifies the element containing a volume where reading of the MAM is requested. The ELEMENT ADDRESS field forms an additional location qualifier hierarchically superior to the VOLUME NUMBER field (see SPC-3) and the PARTITION NUMBER field (see SPC-3). If the element specified by the ELEMENT ADDRESS field is empty, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to MEDIUM SOURCE ELEMENT EMPTY. If the device server does not support reading attribute values from the volume's MAM at the specified element address, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to MEDIUM AUXILIARY MEMORY NOT ACCESSIBLE. The Device Capabilities mode page (see 7.3.2), provides a matrix of element types with the required resources where reading of attribute values are supported.

The ELEMENT TYPE CODE field specifies the element type(s) to report when the SERVICE ACTION field is set to ELEMENT LIST. For all other settings of the SERVICE ACTION field the content of the ELEMENT TYPE CODE field is ignored.

See SPC-3 for a description of the VOLUME NUMBER field, PARTITION NUMBER field, and ALLOCATION LENGTH field.

See SPC-4 for a description of the FIRST ATTRIBUTE IDENTIFIER field.

See SAM-3 for a description of the CONTROL byte.

6.10.2 ELEMENT LIST service action

The parameter data returned in response to an ELEMENT LIST service action reports elements containing volumes with MAM. Only elements with an element type specified by the ELEMENT TYPE field, and an element address greater than or equal to the value specified in the ELEMENT ADDRESS field shall be reported. The format of the returned parameter data is shown in table 21.

Table 21 — READ ATTRIBUTE with ELEMENT LIST service action parameter data format

Bit / Byte	7	6	5	4	3	2	1	0
0	MSB			DESCRIPTORS LENGTH (n-3)				
3								LSB
4				ELEMENT ADDRESS RANGE (first)				
7								
				...				
n-3				ELEMENT ADDRESS RANGE (last)				
N								

The DESCRIPTORS LENGTH field contains the total length in bytes of descriptors that follow. If the descriptors are truncated because of the allocation length then the DESCRIPTORS LENGTH field shall not be affected.

The ELEMENT ADDRESS RANGE descriptor describes a contiguous range of elements of the specified element type containing volumes with MAM. Element address range descriptors shall be returned in ascending order by STARTING ELEMENT ADDRESS field for each element type. The format of an element address range descriptor is shown in table 22.

Table 22 — ELEMENT ADDRESS RANGE descriptor

Bit / Byte	7	6	5	4	3	2	1	0
0	MSB			STARTING ELEMENT ADDRESS				
1								LSB
2	MSB			NUMBER OF ELEMENTS				
3								LSB

The STARTING ELEMENT ADDRESS field indicates the first element address of a contiguous range of elements with an element type selected by the ELEMENT TYPE CODE field containing volumes with MAM.

The NUMBER OF ELEMENTS field indicates the number of contiguous elements containing volumes with MAM that follow the element indicated by the STARTING ELEMENT ADDRESS field.

6.11 READ ELEMENT STATUS command

6.11.1 READ ELEMENT STATUS introduction

The READ ELEMENT STATUS command (see table 23) request that the device server report the status of its internal elements to the application client.

Table 23 — READ ELEMENT STATUS command

Bit / Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (B8h)							
1	Reserved			VOLTAG	ELEMENT TYPE CODE			
2	(MSB)	STARTING ELEMENT ADDRESS						
3								(LSB)
4	(MSB)	NUMBER OF ELEMENTS						
5								(LSB)
6	Reserved						CURDATA	DVCID
7	(MSB)	ALLOCATION LENGTH						
8								
9								(LSB)
10	Reserved							
11	CONTROL							

A volume tag (VOLTAG) bit set to one specifies that the device server shall report volume tag information if this feature is supported. A VOLTAG bit set to zero specifies that volume tag information shall not be reported. If the volume tag feature is not supported, then this bit shall be treated as reserved.

If the current data (CURDATA) bit is set to one, then the device server shall return element status data without causing device motion and shall not perform an inventory scan (see 3.1.14). If the CURDATA bit is set to zero, then the device server may cause device motion and may perform an inventory scan. Support for the CURDATA bit set to one is mandatory.

The ELEMENT TYPE CODE field specifies the particular element type(s) selected for reporting by this command. A value of zero specifies that status for all element types shall be reported. The element type codes are defined in table 24.

Table 24 — Element type code

Code	Description
0h	All element types reported (valid in CDB only)
1h	Medium transport element
2h	Storage element
3h	Import/export element
4h	Data transfer element
5h – Fh	Reserved

The STARTING ELEMENT ADDRESS field specifies the lowest element address to report. Only elements with an element type code permitted by the ELEMENT TYPE CODE field, and an element address greater than or equal to the value specified in the STARTING ELEMENT ADDRESS field shall be reported. Element descriptor blocks are not generated for undefined element addresses.

The NUMBER OF ELEMENTS field specifies the maximum number of element descriptors to be created by the device server for this command. The value specified by this field is not the range of element addresses to be considered for reporting but rather the number of defined elements to report.

The device server shall not return truncated descriptors (i.e., due to an insufficient allocation length specified in the ALLOCATION LENGTH field). An insufficient allocation length shall not be considered an error.

A device ID (DVCID) bit set to one specifies that the device server shall return device identifiers (see 6.11.8), if available, for the specified range. A DVCID bit set to zero specifies that the target shall not return device identifiers. If the DVCID is set to one and the device ID feature is not supported by the media changer, then CHECK CONDITION status shall be returned. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

See SAM-3 for a description of the CONTROL byte.

6.11.2 Element status data

The data returned by the READ ELEMENT STATUS command is defined in table 25 and through table 29. Element status data consists of an eight-byte header (see table 25), followed by zero or more element status pages.

Table 25 — Element status data

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)			FIRST ELEMENT ADDRESS REPORTED				
1								(LSB)
2	(MSB)			NUMBER OF ELEMENTS AVAILABLE				
3								(LSB)
4	Reserved							
5	(MSB)			BYTE COUNT OF REPORT AVAILABLE				
6				(all pages, n-7)				
7								(LSB)
8	Element status page(s)							
n								

The FIRST ELEMENT ADDRESS REPORTED field indicates the element address of the element with the smallest element address found to meet the CDB request.

The NUMBER OF ELEMENTS AVAILABLE field indicates the number of elements meeting the request in the command descriptor block. The status for these elements is returned if sufficient allocation length was specified.

The BYTE COUNT OF REPORT AVAILABLE field indicates the number of bytes of element status page data available for all elements meeting the request in the CDB. This value shall not be adjusted to match the allocation length available.

NOTE 7 — The READ ELEMENT STATUS command may be issued with an allocation length of eight bytes in order to determine the allocation length required to transfer all the element status data specified by the command.

6.11.3 Element status page

The element status page is defined in table 26. Each element status page includes an eight-byte header followed by zero or more element descriptor blocks. The header includes the element type code, the length of each descriptor block and the number of bytes of element descriptor information that follow the header for this element type.

Table 26 — Element status page

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved				ELEMENT TYPE CODE			
1	PVOLTAG	AVOLTAG	Reserved					
2	(MSB)	ELEMENT DESCRIPTOR LENGTH (z)						
3								(LSB)
4	Reserved							
5	(MSB)	BYTE COUNT OF DESCRIPTOR DATA AVAILABLE (this page, y – 7)						
6								
7								(LSB)
8	Element descriptor(s)							
Y								

The ELEMENT TYPE CODE field indicates the element type (see table 24) reported by this page.

A primary volume tag (PVOLTAG) bit set to one indicates that the PRIMARY VOLUME TAG INFORMATION field is present in each of the following element descriptor blocks. A PVOLTAG set to zero indicates that these bytes are omitted from the element descriptors that follow.

An alternate volume tag (AVOLTAG) bit set to one indicates that the ALTERNATE VOLUME TAG INFORMATION field is present in each of the following element descriptor blocks. A AVOLTAG set to zero indicates that these bytes are omitted from the element descriptors that follow.

The ELEMENT DESCRIPTOR LENGTH field indicates the number of bytes in each element descriptor.

The BYTE COUNT OF DESCRIPTOR DATA AVAILABLE field indicates the number of bytes of element descriptor data available for elements of this element type meeting the request in the CDB. This value shall not be adjusted to match the allocation length available.

Each element descriptor includes the element address and status flags; it may also contain sense code information as well as other information depending on the element type (see 6.11.4 through 6.11.8). For each element type, element descriptors shall be returned in ascending element address order.

6.11.4 Medium transport element descriptor

Table 27 defines the medium transport element descriptor.

Table 27 — Medium transport element descriptor

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)			ELEMENT ADDRESS				
1								(LSB)
2	Reserved					EXCEPT	Reserved	FULL
3	Reserved							
4	ADDITIONAL SENSE CODE							
5	ADDITIONAL SENSE CODE QUALIFIER							
6	Reserved							
8								
9	SVALID	INVERT	Reserved		ED	MEDIUM TYPE		
10	(MSB)			SOURCE STORAGE ELEMENT ADDRESS				
11								(LSB)
•••								
(36 bytes)	PRIMARY VOLUME TAG INFORMATION (field omitted if PVOLTAG=0)							
(36 bytes)	ALTERNATE VOLUME TAG INFORMATION (field omitted if AVOLTAG =0)							
•••								
(1 byte)	Reserved				CODE SET			
(1 byte)	Reserved				IDENTIFIER TYPE			
(1 byte)	Reserved							
(1 byte)	IDENTIFIER LENGTH (x)							
(x bytes)	IDENTIFIER							
•••								
to z-1	Vendor-specific							

The ELEMENT ADDRESS field gives the address of the media changer element whose status is reported by this element descriptor block.

An exception (EXCEPT) bit set to one indicates that the element is in an abnormal state. An exception bit set to zero indicates that the element is in a normal state. If the EXCEPT bit is set to one, information on the abnormal state may be available in the ADDITIONAL SENSE CODE field and ADDITIONAL SENSE CODE QUALIFIER field.

A FULL bit set to one indicates that the element contains a unit of media. A FULL bit set to zero indicates that the element does not contain a unit of media.

The ADDITIONAL SENSE CODE field may provide specific information on an abnormal element state. The values in this field are as defined for the ADDITIONAL SENSE CODE field of REQUEST SENSE command response data (see SPC-3). This field is valid only if the EXCEPT bit is set to one.

The ADDITIONAL SENSE CODE QUALIFIER field may provide more detailed information on an abnormal element state. The values in this field are as defined for the ADDITIONAL SENSE CODE QUALIFIER field of REQUEST SENSE command response data (see SPC-3). This field is valid only if the EXCEPT bit is set to one.

A source valid (SVALID) bit set to one indicates that the SOURCE STORAGE ELEMENT ADDRESS field and the INVERT bit information are valid. A SVALID set to zero indicates that the values in these fields are not valid.

An INVERT bit set to one indicates that the unit of media now in this element was inverted by MOVE MEDIUM or EXCHANGE MEDIUM operations since it was last in the SOURCE STORAGE ELEMENT ADDRESS. A INVERT set to zero indicates that no inversion occurred during the operation.

An element disabled (ED) bit set to one indicates that the element is disabled (e.g., a magazine or drive is not installed or has been logically disabled). An ED bit set to zero indicates that the element is enabled.

The MEDIUM TYPE field provides the type of medium currently present in the element as determined by the media changer. Table 28 describes the values for the MEDIUM TYPE field.

Table 28 — Medium type codes

Code	Description
0h	Unspecified. The media changer does not support this field, cannot determine the medium type, or the element is empty
1h	Data medium
2h	Cleaning medium
3h	Diagnostics medium
4h	WORM medium
5h	Microcode image medium
6h – 7h	Reserved

The SOURCE STORAGE ELEMENT ADDRESS field provides the address of the last storage element this unit of media occupied. This field is valid only if the SVALID bit is set to one.

The PRIMARY VOLUME TAG INFORMATION field and ALTERNATE VOLUME TAG INFORMATION field provide identifying information for the unit of media residing in this element (see 5.3). Either or both of these fields may be omitted for all the element descriptor blocks that comprise an element status page as indicated by the PVOLTAG bit and AVOLTAG bit in the element status page header.

The CODE SET field and IDENTIFIER TYPE field are defined in 6.11.8.

The IDENTIFIER LENGTH field contains the length in bytes of the IDENTIFIER field (see 6.11.8). If no device identifier is available, or the DVCID bit in the CDB is set to zero, the IDENTIFIER LENGTH field shall be zero and the CODE SET field and IDENTIFIER TYPE field shall also be zero.

The IDENTIFIER field provides a device identifier for this medium transport element as defined in 6.11.8. If no device identifier is available for this element, or the DVCID bit in the CDB is set to zero, then this field shall be omitted.

6.11.5 Storage element descriptor

Table 29 defines the storage element descriptor.

Table 29 — Storage element descriptor

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)			ELEMENT ADDRESS				
1								(LSB)
2	Reserved				ACCESS	EXCEPT	Reserved	FULL
3	Reserved							
4	ADDITIONAL SENSE CODE							
5	ADDITIONAL SENSE CODE QUALIFIER							
6	Reserved							
8								
9	SVALID	INVERT	Reserved		ED	MEDUIM TYPE		
10	(MSB)			SOURCE STORAGE ELEMENT ADDRESS				
11								(LSB)
•••								
(36 bytes)	PRIMARY VOLUME TAG INFORMATION (field omitted if PVOLTAG=0)							
(36 bytes)	ALTERNATE VOLUME TAG INFORMATION (field omitted if AVOLTAG=0)							
•••								
(1 byte)	Reserved				CODE SET			
(1 byte)	Reserved				IDENTIFIER TYPE			
(1 byte)	Reserved							
(1 byte)	IDENTIFIER LENGTH (x)							
(x bytes)	IDENTIFIER							
•••								
to z-1	Vendor-specific							

An ACCESS bit set to one indicates that access to the element by a medium transport element is allowed. An ACCESS bit set to zero indicates that access to the element by the medium transport element is denied.

The SOURCE STORAGE ELEMENT ADDRESS field provides the address of the last storage element this unit of media occupied. This element address value may or may not be the same as this element. This field is valid only if the SVALID bit is set to one.

The CODE SET field and IDENTIFIER TYPE field are defined in 6.11.8.

The IDENTIFIER LENGTH field contains the length in bytes of the IDENTIFIER field (see 6.11.8). If no device identifier is available, or the DVCID bit in the CDB is set to zero, the IDENTIFIER LENGTH field shall be zero and the CODE SET field and IDENTIFIER TYPE field shall also be zero.

The IDENTIFIER field provides a device identifier for this storage element as defined in 6.11.8. If no device identifier is available for this element, or the DVCID bit in the CDB is zero, this field shall be omitted.

For fields not defined in this subclause, see 6.11.4.

6.11.6 Import/export element descriptor

Table 30 defines the import/export element descriptor.

Table 30 — Import/export element descriptor

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)			ELEMENT ADDRESS				
1								(LSB)
2	OIR	CMC	INENAB	EXENAB	ACCESS	EXCEPT	IMPEXP	FULL
3	Reserved							
4	ADDITIONAL SENSE CODE							
5	ADDITIONAL SENSE CODE QUALIFIER							
6	Reserved							
8								
9	SVALID	INVERT	Reserved		ED	MEDIUM TYPE		
10	(MSB)			SOURCE STORAGE ELEMENT ADDRESS				
11								(LSB)
•••								
(36 bytes)	PRIMARY VOLUME TAG INFORMATION (field omitted if PVOLTAG=0)							
(36 bytes)	ALTERNATE VOLUME TAG INFORMATION (field omitted if AVOLTAG=0)							
•••								
(1 byte)	Reserved				CODE SET			
(1 byte)	Reserved				IDENTIFIER TYPE			
(1 byte)	Reserved							
(1 byte)	IDENTIFIER LENGTH (x)							
(x bytes)	IDENTIFIER							
•••								
To z-1	Vendor-specific							

An operator intervention required (OIR) bit set to one indicates operator intervention is required to make the import/export element accessible. The OIR bit shall be set to zero if no operator intervention is required or if the ACCESS bit is set to one.

A connected media changer (CMC) bit set to one indicates that exports are to a connected media changer and imports are from a connected media changer. A CMC bit set to zero indicates that exports are to the operator and imports are from the operator.

If the CMC bit is set to zero, then media shall not leave the media changer when prevented by the PREVENT ALLOW MEDIA REMOVAL command (see 6.9). If the CMC bit is set to one, the PREVENT ALLOW MEDIA REMOVAL command shall not prevent export operations to a connected media changer.

An import enable (INENAB) bit set to one indicates that the import/export element supports movement of media into the scope of the media changer device. An INENAB bit set to zero indicates that this element does not support import actions.

An export enable (EXENAB) bit set to one indicates that the import/export element supports movement of media out of the scope of the media changer device. An EXENAB bit set to zero indicates that this element does not support export actions.

An ACCESS bit set to one indicates that access to the import/export element by a medium transport element is allowed. An ACCESS bit set to zero indicates access to the import/export element by medium transport elements is denied.

NOTE 8 — An example of when access would be denied is when the operator has exclusive access to the import/export element.

An import export (IMPEXP) bit set to one indicates the unit of media in the import/export element was placed there by an operator. An IMPEXP bit set to zero indicates the unit of media in the import/export element was placed there by the medium transport element.

The CODE SET field and IDENTIFIER TYPE field are defined in 6.11.8.

The IDENTIFIER LENGTH field contains the length in bytes of the IDENTIFIER field (see 6.11.8). If no device identifier is available, or the DVCID bit in the CDB is set to zero, the IDENTIFIER LENGTH field shall be zero and the CODE SET field and IDENTIFIER TYPE field shall also be zero.

The IDENTIFIER field provides a device identifier for this import/export element as defined in 6.11.8. If no device identifier is available for this element, or the DVCID bit in the CDB is zero, this field shall be omitted.

For fields not defined in this subclause, see 6.11.4.

6.11.7 Data transfer element descriptor

Table 31 defines the data transfer element descriptor.

Table 31 — Data transfer element descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			ELEMENT ADDRESS				
1								(LSB)
2	Reserved				ACCESS	EXCEPT	Reserved	FULL
3	Reserved							
4	ADDITIONAL SENSE CODE							
5	ADDITIONAL SENSE CODE QUALIFIER							
6	Obsolete	Reserved	Obsolete	Obsolete	Reserved	Obsolete		
7	Obsolete							
8	Reserved							
9	SVALID	INVERT	Reserved		ED	MEDIUM TYPE		
10	(MSB)			SOURCE STORAGE ELEMENT ADDRESS				
11								(LSB)
•••								
(36 bytes)	PRIMARY VOLUME TAG INFORMATION (field omitted if PVOLTAG=0)							
(36 bytes)	ALTERNATE VOLUME TAG INFORMATION (field omitted if AVOLTAG=0)							
•••								
(1 byte)	Reserved				CODE SET			
(1 byte)	Reserved				IDENTIFIER TYPE			
(1 byte)	Reserved							
(1 byte)	IDENTIFIER LENGTH (x)							
(x bytes)	IDENTIFIER							
•••								
to z-1	Vendor-specific							

An ACCESS bit set to one indicates access to the data transfer element by the medium transport element is allowed. A ACCESS bit set to zero indicates that access to the data transfer element by a medium transport element is denied.

NOTE 9 — Access to the data transfer element by medium transport elements might be denied if a data transfer operation was under way. Note that a one value in this bit may not be sufficient to ensure a successful operation. This bit only reflects the best information available to the media changer device, which may not accurately reflect the state of the data transfer device.

The CODE SET field and IDENTIFIER TYPE field are defined in 6.11.8.

The IDENTIFIER LENGTH field contains the length in bytes of the IDENTIFIER field (see 6.11.8). If no device identifier is available, or the DVCID bit in the CDB is set to zero, the IDENTIFIER LENGTH field shall be zero and the CODE SET field and IDENTIFIER TYPE field shall also be zero.

The IDENTIFIER field provides a device identifier for the data transfer device associated with this data transfer element as defined in 6.11.8. If no device identifier is available for this element, or the DVCID bit in the CDB is set to zero, this field shall be omitted.

For fields not defined in this subclause, see 6.11.4.

6.11.8 Identification descriptor

Table 32 defines the identification descriptor fields returned in element descriptors.

Table 32 — Identification descriptor fields

Bit Byte	7	6	5	4	3	2	1	0
(1 byte)	Reserved				CODE SET			
(1 byte)	Reserved				IDENTIFIER TYPE			
(1 byte)	Reserved							
(1 byte)	IDENTIFIER LENGTH (x)							
(x bytes)	IDENTIFIER							

The CODE SET field, IDENTIFIER TYPE field, IDENTIFIER LENGTH field and IDENTIFIER field in the element descriptor are defined by the device identification page in SPC-3. Device identifiers may be available for some or all elements in a media changer. If no device identifier is available or the DVCID bit in the CDB is set to zero, the IDENTIFIER LENGTH field shall be set to zero, the IDENTIFIER field is omitted, and the CODE SET field and IDENTIFIER TYPE field shall be zero.

Within the element descriptors for a single element status page, the device server may pad IDENTIFIER fields to the right with 00h to achieve a consistent length between such fields.

For a data transfer element, the IDENTIFIER field returns a device identifier from the data transfer device (disk or tape drive) associated with this element. With the exception of 00h padding in the IDENTIFIER field, the same CODE SET field, IDENTIFIER TYPE field, IDENTIFIER LENGTH field, and IDENTIFIER field should be available via an INQUIRY command (see SPC-3) issued to the data transfer device.

For an import/export element, the IDENTIFIER field returns a unique identifier for the import/export device. An element used to exchange media between two media changers should return the same CODE SET field, IDENTIFIER TYPE field, IDENTIFIER LENGTH field, and IDENTIFIER field via either media changer.

For a storage or medium transport element the CODE SET field, IDENTIFIER TYPE field, IDENTIFIER LENGTH field, and IDENTIFIER field refer to the element, and are not an identifier for a volume stored in this location.

6.12 REQUEST DATA TRANSFER ELEMENT INQUIRY command

The REQUEST DATA TRANSFER ELEMENT INQUIRY command (see table 33) requests that the device server return to the application client INQUIRY data (see SPC-3) from the data transfer element at the specified element address. This data shall be for the RMC device server of the data transfer device (see ADC) at the data transfer element address.

Table 33 — REQUEST DATA TRANSFER ELEMENT INQUIRY command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A3h)							
1	Reserved			SERVICE ACTION (06h)				
2	(MSB)	DATA TRANSFER ELEMENT ADDRESS						
3								(LSB)
4	Reserved							EVPD
5	PAGE CODE							
6	(MSB)	ALLOCATION LENGTH						
7								
8								
9								(LSB)
10	Reserved							
11	CONTROL							

See SPC-3 for a description of the OPERATION CODE byte and SERVICE ACTION field. This byte and field shall be set to the values shown in table 33.

The DATA TRANSFER ELEMENT ADDRESS field specifies the data transfer element that is to be used in processing this command. If the address specified has not been assigned or has been assigned to an element other than a data transfer element, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID ELEMENT ADDRESS.

If the DATA TRANSFER ELEMENT ADDRESS field specifies a data transfer element that has been disabled (see 6.11.4), then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to ELEMENT DISABLED.

If the device server does not support providing INQUIRY data for the data transfer device at the data transfer element address specified by the DATA TRANSFER ELEMENT ADDRESS field, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

If the device server supports providing INQUIRY data for the data transfer device at the data transfer element address specified by the DATA TRANSFER ELEMENT ADDRESS field, but is unable to provide the data for this request, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to DATA CURRENTLY UNAVAILABLE.

See SPC-3 for descriptions of the EVPD bit, PAGE CODE field, and ALLOCATION LENGTH field.

If the device server supports any VPD pages for the data transfer device at the data transfer element address specified by the DATA TRANSFER ELEMENT ADDRESS field, then it also shall support the Supported VPD Pages page (i.e., 00h).

See SAM-3 for a description of the CONTROL byte.

6.13 REPORT VOLUME TYPES SUPPORTED command

The REPORT VOLUME TYPES SUPPORTED command (see table 34) requests that information regarding the supported volume types for the device be sent to the application client.

Table 34 — REPORT VOLUME TYPES SUPPORTED command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (44h)							
1	Reserved							
2	Reserved							
3	Reserved							
4	Reserved							
5	Reserved							
6	Reserved							
7	(MSB)			ALLOCATION LENGTH				
8								(LSB)
9	CONTROL							

See SPC-3 for a description of the OPERATION CODE, and ALLOCATION LENGTH field. See SAM-3 for a description of the CONTROL byte.

The REPORT VOLUME TYPES SUPPORTED command shall return a list of volume type and volume qualifier combinations that describe volumes supported by the device in the format shown in table 35.

Table 35 — REPORT VOLUME TYPES SUPPORTED parameter data format

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)			DESCRIPTORS LENGTH (n-7)				
1								(LSB)
2 - 5	Reserved							
6	(MSB)			DESCRIPTORS COUNT				
7								(LSB)
	Volume type descriptors							
8	Volume type descriptor (first)							
	. . .							
	Volume type descriptor (last)							
n								

The DESCRIPTORS LENGTH field contains the total length in bytes of the descriptors to follow. If the descriptors are truncated because of the allocation length, then the DESCRIPTORS LENGTH field shall not be affected.

The DESCRIPTORS COUNT field contains a count of the total number of descriptors to follow. If the descriptors are truncated because of the allocation length, then the DESCRIPTORS COUNT field shall not be affected.

6.13.1 Volume type descriptor

Table 36 defines the volume type descriptor.

Table 36 — Volume type descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	VOLUME TYPE							
1	VOLUME QUALIFIER							
2	Reserved							
3	Reserved				CODE SET			
4 – 6	Reserved							
7	VOLUME DESCRIPTION LENGTH (y-8)							
8	VOLUME DESCRIPTION							
y								

Volume type descriptors shall be returned by ascending VOLUME TYPE field values. Multiple entries may exist for a given VOLUME TYPE field value. For entries that have equal VOLUME TYPE field values the volume type descriptors shall be returned by ascending VOLUME QUALIFIER field values.

For each supported volume type, the device server shall return a volume type descriptor with the VOLUME QUALIFIER field set to All Qualifiers (see table 5). The volume description field shall contain the name for that volume type (e.g., DAT, 8MM, Magneto-Optical).

The VOLUME TYPE field contains a vendor specific value for a volume type that may be used in the device (see 5.4).

The VOLUME QUALIFIER field contains a vendor specific qualifier for a VOLUME TYPE that may be used in the device (see 5.4).

The device server shall return a descriptor for each supported volume type and volume qualifier combination.

The CODE SET field specifies the format of the data in the VOLUME DESCRIPTION field. The supported code set formats are listed in table 37.

Table 37 — CODE SET field

Code	Description
0h-1h	Reserved
2h	The VOLUME DESCRIPTION field contains ASCII printable characters (i.e., code values 20h through 7Eh)
3h	The VOLUME DESCRIPTION field contains UTF-8 codes (see SPC-3)
4h-Fh	Reserved

The VOLUME DESCRIPTION LENGTH field contains the total length in bytes of the VOLUME DESCRIPTION field. The value in the VOLUME DESCRIPTION LENGTH field shall be a multiple of four.

The VOLUME DESCRIPTION field shall contain a null-terminated, null-padded (see SPC-3) vendor specific description in the format specified by the CODE SET field.

6.14 REQUEST VOLUME ELEMENT ADDRESS command

The REQUEST VOLUME ELEMENT ADDRESS command (see table 38) is used to transfer the results of the most recently processed SEND VOLUME TAG command (see 6.15) with the send action code set to a select function. These results shall be cleared by a hard reset and may be cleared by intervening commands or events (e.g., MOVE MEDIUM command, door open). Multiple REQUEST VOLUME ELEMENT ADDRESS commands may be used to retrieve the results of a single SEND VOLUME TAG command.

Device servers that implement the REQUEST VOLUME ELEMENT ADDRESS command shall also implement the SEND VOLUME TAG command.

Table 38 — REQUEST VOLUME ELEMENT ADDRESS command

Bit / Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (B5h)							
1	Reserved			VOLTAG	Obsolete			
2	(MSB)	STARTING ELEMENT ADDRESS						
3								(LSB)
4	(MSB)	NUMBER OF ELEMENTS TO REPORT						
5								(LSB)
6	Reserved							
7	(MSB)	ALLOCATION LENGTH						
8								
9								(LSB)
10	Reserved							
11	CONTROL							

A volume tag (VOLTAG) bit set to one specifies that the device server shall report volume tag information in the element descriptors (see 6.11). A VOLTAG bit set to zero specifies that the device server shall not return volume tag information in the element descriptors.

The STARTING ELEMENT ADDRESS field specifies the lowest element address to report. Only elements with an element address greater than or equal to the value specified in the STARTING ELEMENT ADDRESS field and selected by the last successful SEND VOLUME TAG command shall be reported.

The NUMBER OF ELEMENTS TO REPORT field specifies the maximum number of selected elements to be reported by the device server for this command. If the value in the ALLOCATION LENGTH field is not sufficient to transfer all the element descriptors, then the device server shall return all those descriptors whose complete contents fit within the allocation length and this shall not be considered an error.

See SAM-3 for a description of the CONTROL byte.

The command response data returned by the REQUEST VOLUME ELEMENT ADDRESS command consists of a header as defined by table 39, plus zero or more element status pages in the same format as defined by the READ ELEMENT STATUS command (see 6.11).

Table 39 — REQUEST VOLUME ELEMENT ADDRESS data

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)			FIRST ELEMENT ADDRESS REPORTED				
1								(LSB)
2	(MSB)			NUMBER OF ELEMENTS SELECTED				
3								(LSB)
4	Reserved				SEND ACTION CODE			
5	(MSB)			BYTE COUNT OF REPORT AVAILABLE				
6				(all pages, x – 7)				
7								(LSB)
8	Element status page(s)							
x								

The FIRST ELEMENT ADDRESS REPORTED field indicates the lowest element address found of the remaining selected elements meeting the request of the last successful SEND VOLUME TAG command.

The NUMBER OF ELEMENTS SELECTED field indicates the remaining number of selected elements meeting the request of the last successful SEND VOLUME TAG command. The status for these elements is returned if sufficient allocation length was specified.

The SEND ACTION CODE field in the request volume element address header reports the function performed by the last successful SEND VOLUME TAG command.

The BYTE COUNT OF REPORT AVAILABLE field indicates the number of bytes of element status page data available of the remaining selected element descriptors meeting the request of the last successful SEND VOLUME TAG command. This value shall not be adjusted to match the allocation length available.

In response to a REQUEST VOLUME ELEMENT ADDRESS command, the device server shall report zero or more element status pages in which the selected element descriptors are reported in element address order.

Once a selected element descriptor has been reported it is no longer selected, and shall not be reported with the REQUEST VOLUME ELEMENT ADDRESS command until selected by a subsequent SEND VOLUME TAG command.

If a REQUEST VOLUME ELEMENT ADDRESS command is received and no elements have been selected with the SEND VOLUME TAG command or the element list has been completely reported for the most recent successful SEND VOLUME TAG command, then the logical unit shall return command response data consisting of only the request volume element address header. The fields FIRST ELEMENT ADDRESS REPORTED, NUMBER OF ELEMENTS SELECTED, and the BYTE COUNT OF REPORT AVAILABLE in the request volume element address header shall be set to zero.

NOTE 10 — In order to ensure the successful completion of a SEND VOLUME TAG, REQUEST VOLUME ELEMENT ADDRESS command sequence in a configuration with multiple SCSI initiator devices, it may be necessary to reserve the logical unit to the SCSI initiator port prior to sending the SEND VOLUME TAG command and release the logical unit after the last REQUEST VOLUME ELEMENT ADDRESS command has completed.

6.15 SEND VOLUME TAG command

6.15.1 SEND VOLUME TAG introduction

The SEND VOLUME TAG command (see table 40) is used to select volumes, to associate new volume tag information with a volume, or to clear volume tag information for a volume. The function of the command is conveyed by the SEND ACTION CODE field value. The REQUEST VOLUME ELEMENT ADDRESS command (see 6.14) may be used to transfer the results of a select function. Device servers that implement the SEND VOLUME TAG command shall also implement the REQUEST VOLUME ELEMENT ADDRESS command.

Table 40 — SEND VOLUME TAG command

Bit / Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (B6h)							
1	Reserved				ELEMENT TYPE CODE			
2	(MSB)	ELEMENT ADDRESS						
3								(LSB)
4	Reserved							
5	Reserved			SEND ACTION CODE				
6	Reserved							
7	Reserved							
8	(MSB)	PARAMETER LIST LENGTH						
9								(LSB)
10	Reserved							
11	CONTROL							

The ELEMENT TYPE CODE field specifies the element type (see table 24) to be searched when the SEND ACTION CODE field is set to a select function. If the ELEMENT TYPE CODE field is set to zero, then all element types are candidates for a select function. If the SEND ACTION CODE field is not set to a select function, then this field shall be treated as reserved.

The ELEMENT ADDRESS field specifies an element address whose interpretation depends on the SEND ACTION CODE field. When the SEND ACTION CODE field is set to a select function, the ELEMENT ADDRESS field specifies the starting element to be examined for satisfaction of the select criteria. When the SEND ACTION CODE field is set to an assert, replace, or undefine function, then the ELEMENT ADDRESS field specifies the specific element address where volume tag information for a volume is to be modified.

See SPC-3 for a definition of the PARAMETER LIST LENTH field. See SAM-3 for a description of the CONTROL byte.

6.15.2 Send action codes

The SEND ACTION CODE field specifies the function to be performed by the SEND VOLUME TAG command. The supported send action codes are listed in table 41.

Table 41 — Send action codes

Code	Description
0h	Select - search all defined volume tags - including sequence numbers
1h	Select - search only primary volume tags - including sequence numbers
2h	Select - search only alternate volume tags - including sequence numbers
3h	Reserved
4h	Select - search all defined tags - ignore sequence numbers
5h	Select - search primary tags - ignore sequence numbers
6h	Select - search alternate tags - ignore sequence numbers
7h	Reserved
8h	Assert - as the primary volume tag - if tag now undefined
9h	Assert - as the alternate volume tag - if tag now undefined
Ah	Replace - the primary volume tag - current tag ignored
Bh	Replace - the alternate volume tag – current tag ignored
Ch	Undefine - the primary volume tag - current tag ignored
Dh	Undefine - the alternate volume tag - current tag ignored
0Eh – 1Bh	Reserved
1Ch – 1Fh	Vendor-specific

Select functions requests the logical unit to search the volume tag information available for volumes at defined element addresses for volume tag information that matches the volume identifier template given by the command parameter data. Only volumes residing in elements with the same element type as defined by the ELEMENT TYPE CODE field and with element addresses starting from the element address as defined by the ELEMENT ADDRESS field are searched. When the select function requires checking sequence numbers, only volume tag information with sequence numbers in the range between the minumum and maximum volume sequence numbers given by the command parameter data (see table 41) are searched. The resulting information may be reported via the REQUEST VOLUME ELEMENT ADDRESS command.

Assert functions define volume tag information for a single volume at an element address that does not currently have defined volume tag information. If the volume at the selected element address already has defined volume tag information, then CHECK CONDITION status shall be returned. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB. In this case, the original volume tag information shall not be changed.

Replace functions define or overwrite volume tag information for a single volume at an element address. Any previously defined volume tag information is overwritten.

Undefine functions cause any previously defined volume tag information for the volume at the specified element address to be cleared. It shall not be considered an error to undefine volume tag information that was not previously defined. For undefine functions the PARAMETER LIST LENGTH field shall be set to zero.

If a logical unit implements volume tag information, then it may choose to not implement the functions that modify volume tag information. For such an implementation a request for any assert, replace or undefine function shall cause the SEND VOLUME TAG command to be terminated with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

6.15.3 SEND VOLUME TAG parameter data

The volume identifier template and the minimum and maximum volume sequence nummers sent as command parameter data for the select, assert and replace functions are defined in table 42.

Table 42 — SEND VOLUME TAG parameter data format

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
31				VOLUME IDENTIFIER TEMPLATE				(LSB)
32								
33				Reserved				
34	(MSB)							
35				MINIMUM VOLUME SEQUENCE NUMBER				(LSB)
36								
37				Reserved				
38	(MSB)							
39				MAXIMUM VOLUME SEQUENCE NUMBER				(LSB)

When the SEND ACTION CODE field is set to a select function the VOLUME IDENTIFIER TEMPLATE field specifies a search template.

As a search template, this field may contain the wildcard characters ‘?’ and ‘*’ (3Fh and 2Ah).

a) ‘?’ shall match any single character; and
b) ‘*’ shall match any string of characters. When it appears in a template the remainder of the template at higher offsets in the field is not used.

When the SEND ACTION CODE field is set to an assert or replace function the VOLUME IDENTIFIER TEMPLATE field specifies the value of the new volume identifier for the volume currently residing at the specified element address.

For an assert or replace function, if the VOLUME IDENTIFIER TEMPLATE field contains the ‘?’ or ‘*’ wildcard characters, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The MINIMUM VOLUME SEQUENCE NUMBER field specifies the new sequence number for the assert and replace functions. For a select function, this field specifies the least value in the volume sequence number field of the volume tag information that meets the search specification.

The MAXIMUM VOLUME SEQUENCE NUMBER field specifies the maximum value in a volume sequence number field of the volume tag information that meets the search specification. This field is ignored for assert and replace functions.

6.16 WRITE ATTRIBUTE command

The WRITE ATTRIBUTE command (see table 43) allows an application client to write attribute values to the medium auxiliary memory (MAM) of the volume selected by the value in the ELEMENT ADDRESS field.

Table 43 — WRITE ATTRIBUTE command

Bit / Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (8Dh)							
1	Reserved							
2	(MSB)			ELEMENT ADDRESS				
3								(LSB)
4	Obsolete							
5	VOLUME NUMBER							
6	Reserved							
7	PARTITION NUMBER							
8	Reserved							
9	Reserved							
10	(MSB)			PARAMETER LIST LENGTH				
11								
12								
13								(LSB)
14	Reserved							
15	CONTROL							

The ELEMENT ADDRESS field specifies the element containing a volume where writing of the MAM is requested. The ELEMENT ADDRESS field forms an additional location qualifier hierarchically superior to the VOLUME NUMBER field (see SPC-3) and the PARTITION NUMBER field (see SPC-3). If the element specified by the ELEMENT ADDRESS field is empty, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to MEDIUM SOURCE ELEMENT EMPTY. If the device server does not support writing attribute values at the specified element address, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to MEDIUM AUXILIARY MEMORY NOT ACCESSIBLE. The Device Capabilities mode page (see 7.3.2), provides a matrix of element types with the required resources where writing of attribute values are supported.

See SPC-3 for a description of the VOLUME NUMBER field and the PARTITION NUMBER field.

See SPC-3 for a description of the parameter list format and description of the PARAMETER LIST LENGTH field.

See SAM-3 for a description of the CONTROL byte.

7 Parameters

7.1 Diagnostic parameters

This subclause defines the descriptors and pages for diagnostic parameters used with media changer devices.

The diagnostic page codes for media changer devices are defined in table 44.

Table 44 — Diagnostic page codes

Page code	Description	Reference
00h	Supported diagnostic page	SPC-3
01h – 1Fh	SES diagnostic pages	SES-2
20h – 3Fh	Diagnostic pages assigned by SPC	SPC-3
40h – 7Fh	Reserved for this standard	
80h – FFh	Vendor-specific pages	

7.2 Log parameters

7.2.1 Log page codes

This subclause defines the descriptors and pages for log parameters used with media changer devices.

The log page codes for media changer devices are defined in table 45.

Table 45 — Log page codes

Page Code	Log Page Name	Reference
00h	Supported Log Pages	SPC-3
01h – 05h	Reserved	
06h	Non-Medium Error	SPC-3
07h	Last *n* Error Events	SPC-3
08h – 0Ah	Reserved	
0Bh	Last *n* Deferred Errors or Asynchronous Events	SPC-3
0Ch	Reserved	
0Dh	Temperature	SPC-3
0Eh	Start-Stop Cycle Counter	SPC-3
0Fh	Application Client	SPC-3
10h	Self-Test Results	SPC-3
11h – 13h	Reserved	
14h	Media Changer Statistics	7.2.2
15h	Element Statistics	7.2.3
16h	Media Changer Diagnostics Data	7.2.4

17h – 2Dh	Reserved	
2Eh	TapeAlert	7.2.5
2Fh	Reserved	
30h – 3Eh	Vendor specific	
3Fh	Reserved	

7.2.2 Media Changer Statistics log page

The Media Changer Statistics log page (see table 46) defines data counters associated with the utilization of the media changer device. A device server that implements the Media Changer Statistics log page shall implement one or more of the defined parameters. Support for individual parameters in the Media Changer Statistics log page is optional. All supported parameters shall be persistent across I_T nexus loss, logical unit reset and power-on.

Table 46 — Media Changer Statistics log page

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved		PAGE CODE (14h)					
1	Reserved							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
4	Media changer statistics log parameters							
	First media changer statistics log parameter (see table 47)							
	...							
n	Last media changer statistics log parameter (see table 47)							

See SPC-3 for a description of the PAGE CODE field and PAGE LENGTH field.

The media changer statistics log parameter format is shown in table 47.

Table 47 — Media changer statistics log parameter format

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)	PARAMETER CODE						
1								(LSB)
2	DU	DS	TSD(0)	ETC	TMC		LBIN(0)	LP(0)
3	PARAMETER LENGTH (n-3)							
4	(MSB)	DEVICE STATISTICS DATA COUNTER						
n								(LSB)

See SPC-3 for a description of the PARAMETER CODE field. The PARAMETER CODE field shall contain the values defined in Table 48.

Table 48 — Media changer statistics log parameter codes

Parameter code	Description
0000h	Number of Moves
0001h	Number of Picks
0002h	Number of Pick Retries
0003h	Number of Places
0004h	Number of Place Retries
0005h	Number of determined volume identifiers (i.e., number of times the volume tag information contains a VIQ field (see 5.3.4) set to 00h)
0006h	Number of unreadable volume identifiers (i.e., number of times the volume tag information contains a VIQ field (see 5.3.4) set to 02h)
0007h	Number of Library Door Opens
0008h	Number of Import/Export Door Opens
0009h	Number of Physical Inventory Scans
000Ah	Number of Medium Transport Unrecovered Errors
000Bh	Number of Medium Transport Recovered Errors
000Ch	Number of Medium Transport X Axis Translation Unrecovered Errors
000Dh	Number of Medium Transport X Axis Translation Recovered Errors
000Eh	Number of Medium Transport Y Axis Translation Unrecovered Errors
000Fh	Number of Medium Transport Y Axis Translation Recovered Errors
0010h	Number of Medium Transport Z Axis Translation Unrecovered Errors
0011h	Number of Medium Transport Z Axis Translation Recovered Errors
0012h	Number of Medium Transport Rotational Translation Unrecovered Errors
0013h	Number of Medium Transport Rotational Translation Recovered Errors
0014h	Number of Medium Transport Inversion Translation Unrecovered Errors
0015h	Number of Medium Transport Inversion Translation Recovered Errors
0016h	Number of Medium Transport Auxiliary Axis Translation Unrecovered Errors
0017h	Number of Medium Transport Auxiliary Axis Translation Recovered Errors
0018h – 7FFFh	Reserved
8000h – FFFFh	Vendor specific

NOTE 11 — The exact definition of the data counters is not part of this standard. These counters should not be used to compare products because the products may define the meaning of these counters differently.

See SPC-3 for descriptions of the DU bit, DS bit TSD bit, ETC bit, TMC field, LBIN bit and LP bit. The TSD bit, LBIN bit and LP bit shall be set to the values shown in table 47.

The PARAMETER LENGTH field indicates the number of bytes in the DEVICE STATISTICS DATA COUNTER field that follows.

The DEVICE STATISTICS DATA COUNTER field contains the value of the requested data counter.

7.2.3 Element Statistics log page

The Element Statistics log page (see table 49) defines data counters associated with elements of the media changer device. A device server that implements the Element Statistics log page shall implement one parameter for each element in the media changer device. All parameters shall be persistent across I_T nexus loss, logical unit reset and power-on.

Table 49 — Element Statistics log page

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved		PAGE CODE (15h)					
1	Reserved							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
4	Element statistics log parameters							
	First element statistics log parameter (see table 50)							
	...							
n	Last element statistics log parameter (see table 50)							

See SPC-3 for a description of PAGE CODE field and PAGE LENGTH field.

The element statistics log parameter format is shown in table 50.

Table 50 — Element statistics log parameter format

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)	PARAMETER CODE						
1								(LSB)
2	DU	DS	TSD(0b)	ETC(0b)	TMC(00b)		LBIN(1b)	LP(1b)
3	PARAMETER LENGTH (n-3)							
4	(MSB)	NUMBER OF PLACES						
7								(LSB)
8	(MSB)	NUMBER OF PLACE RETRIES						
11								(LSB)
12	(MSB)	NUMBER OF PICKS						
15								(LSB)
16	(MSB)	NUMBER OF PICK RETRIES						
19								(LSB)
20	(MSB)	NUMBER OF DETERMINED VOLUME IDENTIFIERS						
23								(LSB)
24	(MSB)	NUMBER OF UNREADABLE VOLUME IDENTIFIERS						

27			(LSB)
28	(MSB)	Reserved	
n			(LSB)

See SPC-3 for a description of the PARAMETER CODE field. The PARAMETER CODE field contains the element address for the statistics counters being returned.

See SPC-3 for descriptions of the DU bit, DS bit TSD bit, ETC bit, TMC field, LBIN bit, and LP bit. The TSD bit, ETC bit, TMC field, LBIN bit, and LP bit shall be set to the values shown in table 50.

If the element being described in the log parameter by the PARAMETER CODE field is not a medium transport element, then the NUMBER OF PLACES field contains the number of place operations to the element address indicated in the PARAMETER CODE field. If the element being described in the log parameter by the PARAMETER CODE field is a medium transport element, then the NUMBER OF PLACES field contains the number of place operations by the medium transport element address indicated in the PARAMETER CODE field.

If the element being described in the log parameter by the PARAMETER CODE field is not a medium transport element, then the NUMBER OF PLACE RETRIES field contains the number of retried place operations to the element address indicated in the PARAMETER CODE field. If the element being described in the log parameter by the PARAMETER CODE field is a medium transport element, then the NUMBER OF PLACE RETRIES field contains the number of retried place operations by the medium transport element address indicated in the PARAMETER CODE field.

If the element being described in the log parameter by the PARAMETER CODE field is not a medium transport element, then the NUMBER OF PICKS field contains the number of pick operations from the element address indicated in the PARAMETER CODE field. If the element being described in the log parameter by the PARAMETER CODE field is a medium transport element, then the NUMBER OF PICKS field contains the number of pick operations by the medium transport element address indicated in the PARAMETER CODE field.

If the element being described in the log parameter by the PARAMETER CODE field is not a medium transport element, then the NUMBER OF PICK RETRIES field contains the number of retried pick operations from the element address indicated in the PARAMETER CODE field. If the element being described in the log parameter by the PARAMETER CODE field is a medium transport element, then the NUMBER OF PICK RETRIES field contains the number of retried pick operations by the medium transport element address indicated in the PARAMETER CODE field.

The NUMBER OF DETERMINED VOLUME IDENTIFERS field contains the number of times the VIQ field (see 5.3.4) in the volume tag information was set to 00h for the element address indicated in the PARAMETER CODE field. If the media changer device does not contain a volume tag reader or the element indicated by the PARAMETER CODE field is a medium transport element, then the NUMBER OF DETERMINED VOLUME IDENTIFERS field shall be set to zero.

The NUMBER OF UNREADABLE VOLUME IDENTIFERS field contains the number of times the VIQ field (see 5.3.4) in the volume tag information was set to 02h for the element address indicated in the PARAMETER CODE field. If the media changer device does not contain a volume tag reader or the element indicated by the PARAMETER CODE field is a medium transport element, then the NUMBER OF UNREADABLE VOLUME IDENTIFERS field shall be set to zero.

7.2.4 Media Changer Diagnostic Data log page

The Media Changer Diagnostic Data log page (see table 51) provides for a number of error-event records using the list parameter format. An error-event record contains diagnostic information for an error type encountered by the media changer device including data counters associated with the error event, sense

data, operation code/service action, pick, place, barcode reader statistics and initial and target element addresses of move type operations etc. The Media Changer Diagnostic Data log page may be used to aid in field analysis and repair.

The Media Changer Diagnostic Data log page shall only include parameter entries for commands that terminated with a CHECK CONDITION status having the sense key set to HARDWARE ERROR or ABORTED COMMAND.

The parameter code value associated with an error-event indicates the relative time at which a command terminated with a CHECK CONDITION status. A lower parameter code indicates that the command terminated with a CHECK CONDITION status at a more recent time. The parameter code values returned shall be numbered consecutively from 0000h (i.e., the most recent) up to *n*, where *n* is the number of current parameter entries. The number of supported parameter entries, *n,* is vendor specific.

In each parameter entry (see table 52) if the REPEAT bit is set to zero, then the parameter entry represents only a single event. If the REPEAT bit is set to one, then the parameter entry represents more than one consecutive events that had the identical values for the DESTINATION ADDRESS field, SENSE KEY field, ADDITIONAL SENSE CODE field and ADDITIONAL SENSE CODE QUALIFIER field in the parameter entry. If the REPEAT bit is set to one in the parameter entry, then other fields in the parameter entry shall be set to the values when the first of the consecutive events that had the identical values for the DESTINATION ADDRESS field, SENSE KEY field, ADDITIONAL SENSE CODE field and ADDITIONAL SENSE CODE QUALIFIER field occurred.

All parameter entries shall be persistent across I_T nexus losses, logical unit resets, and power-on. The parameter entries shall not be set to zero or changed with the use of a LOG SELECT command.

Table 51 — Media Changer Diagnostic Data log page

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved		PAGE CODE (16h)					
1	Reserved							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
	Media changer diagnostics data log parameters							
4	First Media changer diagnostics data log parameter (see table 52)							
	...							
n	Last Media changer diagnostics data log parameter (see table 52)							

See SPC-3 for a description of the PAGE CODE field and PAGE LENGTH field.

The media changer diagnostic data log parameter format is shown in table 52.

Table 52 — Media changer diagnostic data log parameter format

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)	PARAMETER CODE						
1								(LSB)
2	DU(0b)	DS	TSD(0b)	ETC(0b)	TMC(00b)		LBIN(1b)	LP(1b)
3	PARAMETER LENGTH (n-3)							
4	Reserved							
5	REPEAT	Reserved			SENSE KEY			
6	ADDITIONAL SENSE CODE							
7	ADDITIONAL SENSE CODE QUALIFIER							
8	(MSB)	VENDOR SPECIFIC CODE QUALIFIER						
11								(LSB)
12	(MSB)	PRODUCT REVISION LEVEL						
15								(LSB)
16	(MSB)	NUMBER OF MOVES						
19								(LSB)
20	(MSB)	NUMBER OF PICKS						
23								(LSB)
24	(MSB)	NUMBER OF PICK RETRIES						
27								(LSB)
28	(MSB)	NUMBER OF PLACES						
31								(LSB)
32	(MSB)	NUMBER OF PLACE RETRIES						
35								(LSB)
36	(MSB)	NUMBER OF DETERMINED VOLUME IDENTIFIERS						
39								(LSB)
40	(MSB)	NUMBER OF UNREADABLE VOLUME IDENTIFIERS						
43								(LSB)
44	OPERATION CODE							
45	Reserved				SERVICE ACTION			
46	MEDIA CHANGER ERROR TYPE							
47	Reserved				MTAV	IAV	LSAV	DAV
48	(MSB)	MEDIUM TRANSPORT ADDRESS						
49								(LSB)
50	(MSB)	INITIAL ADDRESS						
51								(LSB)
52	(MSB)	LAST SUCCESSFUL ADDRESS						
53								(LSB)

54	(MSB)	DESTINATION ADDRESS	
55			(LSB)
56	(MSB)	VOLUME TAG INFORMATION	
:			
:			
91			(LSB)
92	Reserved	TIMESTAMP ORIGIN	
93	Reserved		
94	(MSB)	TIMESTAMP	
99			(LSB)
100		RESERVED	
N			

See SPC-3 for a description of the PARAMETER CODE field.

See SPC-3 for descriptions of the DU bit, DS bit, TSD bit, ETC bit, TMC field, LBIN bit and LP bit. The DU bit, TSD bit, ETC bit, TMC field, LBIN bit, and LP bit shall be set to the values shown in table 52.

The PARAMETER LENGTH field indicates the number of bytes in the media changer diagnostic data log parameter data that follows.

The REPEAT bit set to one indicates this parameter represents more than one consecutive events that had identical values for the DESTINATION ADDRESS field, SENSE KEY field, ADDITIONAL SENSE CODE field, and ADDITIONAL SENSE CODE QUALIFIER field. The REPEAT bit set to zero indicates this parameter represents a single event.

See SPC-3 for descriptions of the SENSE KEY field, ADDITIONAL SENSE CODE field, and ADDITIONAL SENSE CODE QUALIFIER field. The SENSE KEY field, ADDITIONAL SENSE CODE field, and ADDITIONAL SENSE CODE QUALIFIER field shall contain the sense key and additional sense code values of the command that terminated with the CHECK CONDITION status.

The VENDOR SPECIFIC CODE QUALIFIER field is vendor specific. The VENDOR SPECIFIC CODE QUALIFIER may provide additional diagnostics information related to the command that terminated with the CHECK CONDITION status.

See SPC-3 for the descriptions of the PRODUCT REVISION LEVEL field. The PRODUCT REVISION LEVEL field shall contain the product revision level at the time the command terminated with the CHECK CONDITION status.

The NUMBER OF MOVES field contains the number of moves from all elements at the time the command terminated with the CHECK CONDITION status. The NUMBER OF MOVES field is equivalent to the value contained in the Media Changer Statistics log page (see 7.2.2) with a parameter code of 0000h at the time the command terminated with the CHECK CONDITION status.

The NUMBER OF PICKS field contains the number of picks from all elements at the time the command terminated with the CHECK CONDITION status. The NUMBER OF PICKS field is equivalent to the value contained in the Media Changer Statistics log page (see 7.2.2) with a parameter code of 0001h at the time the command terminated with the CHECK CONDITION status.

The NUMBER OF PICK RETRIES field contains the number of pick retries from all elements at the time the command terminated with the CHECK CONDITION status. The NUMBER OF PICK RETRIES field is equivalent to the value contained in the Media Changer Statistics log page (see 7.2.2) with a parameter code of 0002h at the time the command terminated with the CHECK CONDITION status.

The NUMBER OF PLACES field contains the number of places to all elements at the time the command terminated with the CHECK CONDITION status. The NUMBER OF PLACES field is equivalent to the value contained in the Media Changer Statistics log page (see 7.2.2) with a parameter code of 0003h at the time the command terminated with the CHECK CONDITION status.

The NUMBER OF PLACE RETRIES field contains the number of place retries to all elements at the time the command terminated with the CHECK CONDITION status. The NUMBER OF PLACE RETRIES field is equivalent to the value contained in the Media Changer Statistics log page (see 7.2.2) with a parameter code of 0004h at the time the command terminated with the CHECK CONDITION status.

The NUMBER OF DETERMINED VOLUME IDENTIFERS field contains the number of times the VIQ field (see 5.3.4) in the volume tag information was set to 00h for all element addresses at the time the command terminated with the CHECK CONDITION status. The NUMBER OF DETERMINED VOLUME IDENTIFERS field is equivalent to the value contained in the Media Changer Statistics log page (see 7.2.2) with a parameter code of 0005h at the time the command terminated with the CHECK CONDITION status. If the media changer device does not contain a volume tag reader, then the NUMBER OF DETERMINED VOLUME IDENTIFERS field shall be set to zero.

The NUMBER OF UNREADABLE VOLUME IDENTIFERS field contains the number of times the VIQ field (see 5.3.4) in the volume tag information was set to 02h for all element addresses at the time the command terminated with the CHECK CONDITION status. The NUMBER OF UNREADABLE VOLUME IDENTIFERS field is equivalent to the value contained in the Media Changer Statistics log page (see 7.2.2) with a parameter code of 0006h at the time the command terminated with the CHECK CONDITION status. If the media changer device does not contain a volume tag reader, then the NUMBER OF UNREADABLE VOLUME IDENTIFERS field shall be set to zero.

See SPC-3 for descriptions of the OPERATION CODE field and SERVICE ACTION field. The OPERATION CODE field and SERVICE ACTION field if applicable contain the operation code and service action of the command that terminated with the CHECK CONDITION status.

Table 53 describes the contents of the MEDIA CHANGER ERROR TYPE field.

Table 53 — MEDIA CHANGER ERROR TYPE field

Code	Description
00h	No error or unknown error
01h	Error occurred during a positioning operation of a medium transport(e.g., an error occurred position the medium transport prior to a pick or place operation)
02h	Error occurred during a pick operation by a medium transport
03h	Error occurred during a place operation by a medium transport
04h	Error occurred during an invert operation by a medium transport
05h	Error occurred during an open/close operation of an import/export element

06h – 7Fh	Reserved
80h – FFh	Vendor specific

A medium transport address valid (MTAV) bit set to one indicates that the content of the MEDIUM TRANSPORT ADDRESS field in the parameter entry is valid. A medium transport address valid (MTAV) bit set to zero indicates that the content of the MEDIUM TRANSPORT ADDRESS field in the parameter entry is ignored.

An initial address valid (IAV) bit set to one indicates that the content of the INITIAL ADDRESS field in the parameter entry is valid. An initial address valid (IAV) bit set to zero indicates that the content of the INITIAL ADDRESS field in the parameter entry is ignored.

A last successful address valid (LSAV) bit set to one indicates that the content of the LAST SUCCESSFUL ADDRESS field in the parameter entry is valid. A last successful address valid (LSAV) bit set to zero indicates that the content of the LAST SUCCESSFUL ADDRESS field in the parameter entry is ignored.

A destination address valid (DAV) bit set to one indicates that the content of the DESTINATION ADDRESS field information in the parameter entry is valid. A destination address valid (DAV) bit set to zero indicates that the content of the DESTINATION ADDRESS field in the parameter entry is ignored.

Table 54 describes the contents of the MEDIUM TRANSPORT ADDRESS field and MTAV bit when the MEDIA CHANGER ERROR TYPE field is set to a specific code value.

Table 54 — MEDIUM TRANSPORT ADDRESS field and MTAV bit

MEDIA CHANGER ERROR TYPE **field code**	MEDIUM TRANSPORT ADDRESS **field and** MTAV **bit contents**
00h	The MEDIUM TRANSPORT ADDRESS field is ignored. The MTAV bit shall be set to zero.
01h	The MEDIUM TRANSPORT ADDRESS field contains the element address of the medium transport involved in the positioning operation error. The MTAV bit shall be set to one.
02h	The MEDIUM TRANSPORT ADDRESS field contains the element address of the medium transport involved with the pick operation error. The MTAV bit shall be set to one.
03h	The MEDIUM TRANSPORT ADDRESS field contains the element address of the medium transport involved with the place operation error. The MTAV bit shall be set to one.
04h	The MEDIUM TRANSPORT ADDRESS field contains the element address of the medium transport involved with the invert operation error. The MTAV bit shall be set to one.
05h	The MEDIUM TRANSPORT ADDRESS field is ignored. The MTAV bit shall be set to zero.
06h – 7Fh	n/a
80h – FFh	The contents of the MEDIUM TRANSPORT ADDRESS field and MTAV bit are vendor specific.

Table 55 describes the contents of the INITIAL ADDRESS field and IAV bit, when the MEDIA CHANGER ERROR TYPE field is set to a specific code value.

Table 55 — INITIAL ADDRESS field and IAV bit contents

MEDIA CHANGER ERROR TYPE **field code**	INITIAL ADDRESS **field and** IAV **bit contents**
00h	The INITIAL ADDRESS field is ignored. The IAV bit shall be set to zero.
01h	If the medium transport was at a defined element address, then the INITIAL ADDRESS field contains the element address at which the medium transport was located, at the time the task entered the enabled task state (see SAM-3) (i.e., the position of the robotics prior to moving to an element address required by the command) and the IAV bit shall be set to one. If the medium transport was not at a defined element address and media changer supports the ability to determine the element address closest to the initial location at the time the task entered the enabled task state, then the INITIAL ADDRESS field should contain that element address and the IAV bit should be set to one. If the element address is not known, then the IAV bit shall be set to zero.
02h – 05h	The INITIAL ADDRESS field is ignored. The IAV bit shall be set to zero.
06h – 7Fh	n/a
80h – FFh	The contents of the INITIAL ADDRESS field and IAV bit are vendor specific.

Table 56 describes the contents of the LAST SUCCESSFUL ADDRESS field and LSAV bit, when the MEDIA CHANGER ERROR TYPE field is set to a specific code value.

Table 56 — LAST SUCCESSFUL ADDRESS field and LSAV bit contents

MEDIA CHANGER ERROR TYPE **field code**	LAST SUCCESSFUL ADDRESS **field and** LSAV **bit contents**
00h	The LAST SUCCESSFUL ADDRESS field is ignored. The LSAV bit shall be set to zero.
01h	If the medium transport successfully positioned to an element address as required by the command, then the LAST SUCCESSFUL ADDRESS field contains the last element address to which the medium transport successfully positioned. The LSAV bit shall be set to one. If the medium transport did not successfully positioned to an element address from the starting initial address, then the LAST SUCCESSFUL ADDRESS field is ignored. The LSAV bit shall be set to zero.
02h – 05h	The LAST SUCCESSFUL ADDRESS field is ignored. The LSAV bit shall be set to zero.
06h – 7Fh	n/a
80h – FFh	The contents of the LAST SUCCESSFUL ADDRESS field and LSAV bit are vendor specific.

Table 57 describes the contents of the DESTINATION ADDRESS field and DAV bit, when the MEDIA CHANGER ERROR TYPE field is set to a specific code value.

Table 57 — DESTINATION ADDRESS field and DAV bit contents

MEDIA CHANGER ERROR TYPE **field code**	DESTINATION ADDRESS **field and** DAV **bit contents**
00h	The DESTINATION ADDRESS field is ignored. The DAV bit shall be set to zero.
01h	The DESTINATION ADDRESS field contains the element address to which the medium transport was positioning at the time the error occurred. The DAV bit shall be set to one.
02h	The DESTINATION ADDRESS field contains the element address at which the medium transport was when the pick operation error occurred. The DAV bit shall be set to one.
03h	The DESTINATION ADDRESS field contains the element address at which the medium transport was when the place operation error occurred. The DAV bit shall be set to one.
04h	The DESTINATION ADDRESS field contains the element address at which the medium transport was when the invert operation error occurred. The DAV bit shall be set to one.
05h	The DESTINATION ADDRESS field contains the element address of the import/export element. The DAV bit shall be set to one.
06h – 7Fh	n/a

80h – FFh	The contents of the DESTINATION ADDRESS field and DAV bit are vendor specific.

The VOLUME TAG INFORMATION field contains the volume tag information (see 5.3.4) of the volume. If the MEDIA CHANGER ERROR TYPE field contains a value of 01h through 05h, then the VOLUME TAG INFORMATION field contains the volume tag information of the volume involved with the error (e.g., the volume that was trying to be picked when the pick operation error occurred).

See SPC-3 for descriptions of the TIMESTAMP ORIGIN and TIMESTAMP fields. The TIMESTAMP ORIGIN field and TIMESTAMP field contain the timestamp origin and timestamp maintained by the device server at the time the command terminated with the CHECK CONDITION status. If a timestamp is not supported by the device server, the TIMESTAMP ORIGIN and TIMESTAMP fields shall be set to zero.

7.2.5 TapeAlert log page

Support for the TapeAlert log page (see table 58) is optional for media changers. If supported, then the TapeAlert log page shall operate using the flag definitions in Annex A of this standard.

Table 58 — TapeAlert log page

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved		PAGE CODE (2Eh)					
1	Reserved							
2	(MSB)	PAGE LENGTH (140h)						
3								(LSB)
5n-1	(MSB)	PARAMETER CODE						
5n								(LSB)
5n+1	DU(0)	DS(1)	TSD(0)	ETC(0)	TMC(00b)		LBIN(0)	LP(0)
5n+2	PARAMETER LENGTH (01h)							
5n+3	Value of flag							

7.3 Mode parameters

7.3.1 Mode page codes

This subclause defines the descriptors and pages for mode parameters used with media changer devices.

The mode parameter list, including the mode parameter header and mode block descriptor, are defined in SPC-3.

The MEDIUM TYPE code field is contained in the mode parameter header. This field is reserved for media changer devices.

The DEVICE–SPECIFIC PARAMETER field is contained in the mode parameter header. This field is reserved for media changer devices.

The DENSITY CODE, NUMBER OF BLOCKS and BLOCK LENGTH fields are contained in the mode parameter block descriptor. These fields are reserved for media changer devices.

The mode page codes and subpage codes for media changer devices are shown in table 59.

Table 59 — Mode page codes and subpage codes

Page code	Subpage code	Mode page names	Support	Reference
00h	Not applicable	Vendor-specific (does not require page format)		
01h	00h – FEh	Reserved		
02h	00h	Disconnect Reconnect	O	SPC-3
03h - 09h	00h – FEh	Reserved		
0Ah	00h	Control	O	SPC-3
0Ah	01h	Control Extension	O	SPC-3
0Bh - 17h	00h – FEh	Reserved		
18h	00h	Protocol Specific LUN	M [b]	SPC-3
19h	00h	Protocol Specific Port	M [c]	SPC-3
1Ah	00h	Power Condition	O	SPC-3
1Bh	00h – FEh	Reserved		
1Ch	00h	Informational Exceptions Control	O	SPC-3
1Dh	00h	Element Address Assignment	M	7.3.4
1Eh	00h	Transport Geometry Parameters	M	7.3.5
1Fh	00h	Device Capabilities	M	7.3.2
1Fh	41h	Extended Device Capabilities	M	7.3.3
20h – 3Eh	00h	Vendor-specific (page_0 format required)		
20h – 3Eh	01h – FEh	Vendor-specific (sub_page format required)		
00h – 3Eh	FFh	Return all subpages for the specified mode page in the page_0 format for subpage 00h and in the sub_page format for subpages 01h – FEh [a]	M	
3Fh	00h	Return all subpage 00h mode pages in page_0 format [a]	M	SPC-3
3Fh	FFh	Return all subpages for all mode pages in the page_0 format for subpage 00h and in the sub_page format for subpages 01h – FEh [a]	M	SPC-3

All page code and subpage code combinations not shown in this table are reserved.

Support type: M = Mandatory
O = Optional

[a] Valid only for the MODE SENSE command

[b] Mandatory if supported by the transport protocol

[c] Mandatory if supported by the transport protocol and the logical unit is presented on LUN 0, otherwise optional

7.3.2 Device Capabilities mode page

The Device Capabilities mode page (see table 60) defines characteristics of the element types of an media changer. This information may be employed by the application client to determine functions permitted by the MOVE MEDIUM and EXCHANGE MEDIUM commands.

Table 60 — Device Capabilities mode page

Bit Byte	7	6	5	4	3	2	1	0
0	PS	SPF(0b)	PAGE CODE (1Fh)					
1	PARAMETER LENGTH (12h)							
2	Reserved				STORDT	STORI/E	STORST	STORMT
3	Reserved					ACE	VTRP	S2C
4	MT->RA		Reserved		MT->DT	MT -> I/E	MT -> ST	MT -> MT
5	ST->RA		Reserved		ST->DT	ST -> I/E	ST -> ST	ST -> MT
6	I/E->RA		Reserved		I/E->DT	I/E -> I/E	I/E -> ST	I/E -> MT
7	DT->RA		Reserved		DT->DT	DT -> I/E	DT -> ST	DT -> MT
8 11	Reserved							
12	MT->WA		Reserved		MT<>DT	MT <> I/E	MT <> ST	MT <> MT
13	ST ->WA		Reserved		ST<>DT	ST <> I/E	ST <> ST	ST <> MT
14	I/E ->WA		Reserved		I/E<>DT	I/E <> I/E	I/E <> ST	I/E <> MT
15	DT ->WA		Reserved		DT<>DT	DT <> I/E	DT <> ST	DT <> MT
16 19	Reserved							

The parameters savable (PS) bit is only used with the MODE SENSE command. This bit is reserved with the MODE SELECT command. A PS bit set to one indicates that the SCSI device is capable of saving the page in a nonvolatile, vendor-specific location.

The field names in table 60 use the following element type abbreviations:

a) MT — a medium transport element;
b) ST — a storage element;
c) I/E — an import/export element; and
d) DT — a data transfer element.

In the descriptions, XX and YY are any of the element type abbreviations.

A STORXX bit value of one indicates that the defined elements of type XX may provide independent storage for a unit of media. A value of zero indicates that elements of type XX provide virtual sources or destinations and that the location of the unit of media is provided by an element of some other type. If any storage elements exist, then the value of STORST is one by the definition of that type (see 5.2.3).

An XX->YY bit value of one indicates that the media changer device supports all MOVE MEDIUM commands where the source is element type XX, the destination is element type YY and these element addresses are otherwise valid. An XX->YY bit value of zero indicates that these MOVE MEDIUM commands may or may not be valid depending on the particular elements requested. Those that are not valid shall be rejected with CHECK CONDITION status and a sense key of ILLEGAL REQUEST.

An XX<>YY bit value of one indicates that the media changer device supports all EXCHANGE MEDIUM commands where the source is element type XX, FIRST DESTINATION ADDRESS is element type YY, SECOND DESTINATION ADDRESS is the same type as the source element type and these element addresses are otherwise valid. An XX<>YY bit value of zero indicates that these EXCHANGE MEDIUM commands may or may not be valid depending on the particular elements requested. Those which are not valid shall be rejected with CHECK CONDITION status and a sense key of ILLEGAL REQUEST.

The SMC-2 Capabilities (S2C) bit shall be set to one when the VTRP, ACE, XX-RA, and XX-WA fields are supported. The S2C bit shall be set to zero when any of these fields are not supported.

The Volume Tag Reader Present (VTRP) bit shall be set to one by the device server to indicate that a volume tag reader is installed in the media changer (e.g. optical bar code reader). The VTRP bit shall be set to zero to indicate that a volume tag reader is not present or is not functional.

The Auto-clean Enabled (ACE) shall be set to one if the device server is managing the data transfer element cleaning process. This ACE bit shall be set to zero if the device server is not managing the cleaning process.

The XX-RA and XX-WA fields indicate the resources required to support the READ ATTRIBUTE (RA) and WRITE ATTRIBUTE (WA) commands for each element type. If the required resources are not available, then the device server may reject a READ ATTRIBUTE or WRITE ATTRIBUTE command. Alternately, the device server may accept the command but delay processing it until resources are available. Table 61 describes the values for these fields.

Table 61 — XX-RA and XX-WA codes

Code	Description
0h	No MAM access available. READ ATTRIBUTE and WRITE ATTRIBUTE commands that access elements of this type shall be rejected by the device server with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
1h	No resources required for MAM access. The device server shall introduce little or no delay in processing of READ ATTRIBUTE and WRITE ATTRIBUTE commands due to resources.
2h	Medium transport element required for MAM access. If no medium transport elements are available, then the device server may return CHECK CONDITION status to a READ ATTRIBUTE or WRITE ATTRIBUTE command addressed to elements of this type. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
3h	Medium transport and data transfer element required for MAM access. If no medium transport elements are available, or no data transfer elements are available, then the device server may return CHECK CONDITION status to a READ ATTRIBUTE or WRITE ATTRIBUTE command addressed to elements of this type. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

7.3.3 Extended Device Capabilities mode page

The Extended Device Capabilities mode page (see table 62) defines characteristics of the media changer. Media changers shall return this page. This information may be employed by the application client to determine capabilities performed by the media changer.

Table 62 — Extended Device Capabilities mode page

Bit / Byte	7	6	5	4	3	2	1	0
0	PS (0)	SPF (1b)	PAGE CODE (1Fh)					
1	SUBPAGE CODE (41h)							
2	(MSB)	PAGE LENGTH (10h)						
3								(LSB)
4	Reserved		MVPRV	MVCL	MVOP	USRCL	USROP	IEST
5	Reserved			DTEDA	RSSTA	MVTRY	IEMGZ	SMGZ
6	Reserved					TREXC	LCKIE	LCKD
7	Reserved					SPMER	DPMER	PEPOS
8	Reserved							UCST
9 - 19	Reserved							

The parameters savable (PS) bit is only used with the MODE SENSE command. This bit is reserved with the MODE SELECT command. A PS bit set to one indicates that the device server is capable of saving the page in a nonvolatile vendor specific location. A PS bit set to zero indicates that the device server is not able to save the page.

A SubPage Format (SPF) bit set to one indicates that the subpage mode page format is being used.

An import/export element state (IEST) bit set to one indicates that the media changer is able to detect medium presence in all import/export elements. An IEST bit set to zero indicates that the media changer is not able to detect medium presence in all import/export elements.

A user control import/export element open (USROP) bit set to one indicates that the media changer requires the operator to manually open a closed import/export element. An USROP bit set to zero indicates that the media changer does not require the operator to manually open a closed import/export element.

A user control import/export element close (USRCL) bit set to one indicates that the media changer requires the operator to manually close an open import/export element. An USRCL bit set to zero indicates that the media changer does not require the operator to manually close an open import/export element.

A move opens import/export element (MVOP) bit set to one indicates that the media changer opens the import/export element for operator access whenever a command is issued to move media with an import/export element as a destination element address. An MVOP bit set to zero indicates that the media changer does not open the import export element for operator access whenever a command is issued to move media with an import/export element as a destination element address.

A move closes import/export element (MVCL) bit set to one indicates that the media changer will closes the import/export element whenever a command is issued to move media from an open import/export element. An MVCL bit set to zero indicates that the media changer does not close the import/export element whenever a command is issued to move media from an open import/export element.

A move prevented to import/export element (MVPRV) bit set to one indicates that the media changer prevents moves with the import/export element as destination element address when medium removal is prevented with the PREVENT ALLOW MEDIUM REMOVAL command. An MVPRV bit set to zero indicates that the media changer does not prevent moves with the import/export element as destination element address when medium removal is prevented with the PREVENT ALLOW MEDIUM REMOVAL command.

A storage magazine (SMGZ) bit set to one indicates that the media changer uses medium magazines for some storage elements. A SMGZ bit set to zero indicates that the media changer does not use medium magazines for any storage element.

An import/export magazine (IEMGZ) bit set to one indicates that the media changer uses medium magazines for some import/export elements. An IEMGZ bit set to zero indicates that the media changer does not use medium magazines for any import/export element.

A move tray (MVTRY) bit set to one indicates that the media changer uses removable trays in its elements, which requires the medium to be placed in a tray and the tray moved to the desired position. An MVTRY bit set to zero indicates that the media changer does not use trays in its elements.

A return to source storage element address (RSSEA) bit set to one indicates that the media changer requires the application client to return the medium to the element address specified in the SOURCE STORAGE ELEMENT ADDRESS field (see 6.11.4). An RSSEA bit set to zero indicates that the application client does not need to return the medium to the element address specified in the SOURCE STORAGE ELEMENT ADDRESS field.

A data transfer element empty on door access (DTEDA) bit set to one indicates that the media changer requires all data transfer elements not contain media before access via the door is possible. A DTEDA bit set to zero indicates that the door may be opened while data transfer elements contain media.

A true exchange capable (TREXC) bit set to one indicates that the media changer allows an EXCHANGE MEDIUM command that has the second destination element address equal to the source element address. A TREXC bit set to zero indicates that the media changer does not allow an EXCHANGE MEDIUM command that has the second destination element address equal to the source element address.

A lock door (LCKD) bit set to one indicates that the PREVENT ALLOW MEDIUM REMOVAL command with the PREVENT field set to 01b secures the media changer door(s). An LCKD bit set to zero indicates that the PREVENT ALLOW MEDIUM REMOVAL command with the PREVENT field set to 01b does not secure the media changer door(s).

A lock import/export element (LCKIE) bit set to one indicates that the PREVENT ALLOW MEDIUM REMOVAL command with the PREVENT field set to 01b secures the media changer import/export element(s). An LCKIE bit set to zero indicates that the PREVENT ALLOW MEDIUM REMOVAL command with the PREVENT field set to 01b does not secure the media changer import/export element(s).

An pre-eject position (PEPOS) bit set to one indicates that the media changer requires a POSITION TO ELEMENT command to position the medium transport element to a data transfer element before an eject (see SSC-3). An PEPOS bit set to zero indicates that the media changer does not require a POSITION TO ELEMENT command to position the medium transport element to a data transfer element before an eject.

A destination pre-move eject required (DPMER) bit set to one indicates that the media changer requires the application client to send an explicit command to the data transfer element to extend the drive mechanism before the media changer is able to move the medium to the data transfer element. (e.g. a CD-ROM changer that requires the tray to be presented before the MOVE MEDIUM operation starts). A DPMER bit set to zero indicates that the application client does not need to send an explicit command to the data transfer element before the media changer is able to move the medium to the data transfer element.

A source pre-move eject required (SPMER) bit set to one indicates that the media changer requires the application client to send an explicit command to the data transfer element to eject (see SSC-3) the medium before the media changer is able to move the medium from the data transfer element. A SPMER bit set to zero indicates that the application client does not need to send an explicit command to the data transfer element to eject the medium before the media changer is able to move the medium from a data transfer element.

An unassigned cleaning storage (UCST) bit set to one indicates that the device server does not assign element addresses to the physical entities that contain cleaning media. These unassigned physical entities are not reported in the READ ELEMENT STATUS data. A UCST bit set to zero indicates that the device server assigns element addresses to physical entities that contain cleaning media.

7.3.4 Element Address Assignment mode page

The Element Address Assignment mode page (see table 63) is used to assign addresses to the elements of the media changer (MODE SELECT) and to report those assignments (MODE SENSE). This page also defines the number of each type of element present.

Table 63 — Element Address Assignment mode page

Bit / Byte	7	6	5	4	3	2	1	0
0	PS	SPF(0b)	PAGE CODE (1Dh)					
1	PARAMETER LIST LENGTH							
2	(MSB)	FIRST MEDIUM TRANSPORT ELEMENT ADDRESS						
3								(LSB)
4	(MSB)	NUMBER OF MEDIUM TRANSPORT ELEMENTS						
5								(LSB)
6	(MSB)	FIRST STORAGE ELEMENT ADDRESS						
7								(LSB)
8	(MSB)	NUMBER OF STORAGE ELEMENTS						
9								(LSB)
10	(MSB)	FIRST IMPORT/EXPORT ELEMENT ADDRESS						
11								(LSB)
12	(MSB)	NUMBER OF IMPORT/EXPORT ELEMENTS						
13								(LSB)
14	(MSB)	FIRST DATA TRANSFER ELEMENT ADDRESS						
15								(LSB)
16	(MSB)	NUMBER OF DATA TRANSFER ELEMENTS						
17								(LSB)
18	Reserved							
19								

The parameters savable (PS) bit is only used with the MODE SENSE command. This bit is reserved with the MODE SELECT command. A PS bit set to one indicates that the device server is capable of saving the page in a nonvolatile vendor-specific location.

The FIRST MEDIUM TRANSPORT ELEMENT ADDRESS field identifies the first medium transport element contained in the media changer (other than the default medium transport address of zero). The NUMBER OF MEDIUM TRANSPORT ELEMENTS field defines the total number of medium transport elements contained in the media changer. If the NUMBER OF MEDIUM TRANSPORT ELEMENTS field in a MODE SELECT command is greater than the default value returned in the MODE SENSE parameter data, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to PARAMETER VALUE INVALID.

The FIRST STORAGE ELEMENT ADDRESS field identifies the first medium storage element contained in the media changer. The NUMBER OF STORAGE ELEMENTS field defines the total number of

medium storage elements contained in the media changer. If the NUMBER OF MEDIUM STORAGE ELEMENTS field in a MODE SELECT command is greater than the default value returned in the MODE SENSE parameter data, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to PARAMETER VALUE INVALID.

The FIRST IMPORT/EXPORT ELEMENT ADDRESS field identifies the first medium portal that is accessible both by the medium transport devices and also by an operator from outside the media changer. The NUMBER OF IMPORT/EXPORT ELEMENTS field defines the total number of import/export elements contained in the media changer and accessible to the medium transport elements. If the NUMBER OF IMPORT/EXPORT ELEMENTS field in a MODE SELECT command is greater than the default value returned in the MODE SENSE parameter data, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to PARAMETER VALUE INVALID.

The FIRST DATA TRANSFER ELEMENT ADDRESS field identifies the first data transfer element contained in the media changer. The data transfer elements may be either read/write or read-only devices. The NUMBER OF DATA TRANSFER ELEMENTS field defines the total number of data transfer elements contained within the media changer and accessible to the medium transport elements. If the NUMBER OF DATA TRANSFER ELEMENTS field in a MODE SELECT command is greater than the default value returned in the MODE SENSE parameter data, then the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to PARAMETER VALUE INVALID.

NOTE 12 — The number of import/export elements or data transfer elements may be zero. The number of storage elements may only be zero when there is at least one import/export element with independent storage capability (see 5.2.3).

Each element in the media changer shall have a unique address. If the address ranges defined for any of the element types overlap for a MODE SELECT command, then the device server shall terminateh the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST, and the additional sense code set to INVALID ELEMENT ADDRESS.

7.3.5 Transport Geometry Parameters mode page

The Transport Geometry Parameters mode page (see table 64) indicates whether each medium transport element of an media changer is a member of a set of elements that share common robotics and whether the element is capable of media rotation. One transport geometry descriptor is transferred for each medium transport element, beginning with the first medium transport element (other than the default transport element address of zero).

Table 64 — Transport Geometry Parameters mode page

Bit Byte	7	6	5	4	3	2	1	0
0	PS	SPF(0b)	PAGE CODE (1Eh)					
1	PARAMETER LENGTH (n-1)							
2	Transport geometry descriptor(s)							
n								

The parameters savable (PS) bit is only used with the MODE SENSE command. This bit is reserved with the MODE SELECT command. A PS bit set to one indicates that the SCSI device is capable of saving the page in a nonvolatile vendor-specific location.

The PARAMETER LENGTH specifies the number of bytes of transport geometry descriptors that follow. The geometry of each medium transport element is defined using a two-byte field as defined by table 65.

Table 65 — Transport geometry descriptor

Bit Byte	7	6	5	4	3	2	1	0
0	Reserved							ROTATE
1	MEMBER NUMBER IN TRANSPORT ELEMENT SET							

A ROTATE bit set to one indicates that the medium transport element supports media rotation for handling double-sided media. A ROTATE bit set to zero indicates that the medium transport element does not support media rotation.

The MEMBER NUMBER IN TRANSPORT ELEMENT SET field indicates the position of this element in a set of medium transport elements that share common robotics. The first element in a set has a MEMBER NUMBER IN TRANSPORT ELEMENT SET of zero.

NOTE 13 — This mode page reports information about the way transport elements are physically clustered in a system. The model for this is a media changer device with more than one independent robotics subsystem, where each of these supports multiple transport elements. The elements that are supported by a particular robotics subsystem form a set. This sort of information is helpful for optimization and error recovery in such a large system. The individual transport element is addressed, not the robotics subsystem. An element is defined to be a place where a unit of media may be at any point in time. See clause 5.2.

Annex A

(normative)

A.1 TapeAlert Flags

Table A.1 is a listing of TapeAlert flags in numeric order.

Table A.1 — TapeAlert Flags for media changers (part 1 of 4)

Code	Flag	Type	Flag Type	Recommended application client message	Probable cause
01h	Library Hardware A	O	C	The library mechanism is having difficulty communicating with the drive: 1. Turn the library off then on. 2. Restart the operation. 3. If the problem persists, call the library supplier help line.	Changer mechanism is having trouble communicating with the internal drive
02h	Library Hardware B	M	W	There is a problem with the library mechanism. If problem persists, call the library supplier help line.	Changer mechanism has a hardware fault
03h	Library Hardware C	O	C	The library has a hardware fault: 1. Reset the library. 2. Restart the operation. Check the library users manual for device specific instructions on resetting the device.	The changer mechanism has a hardware fault that requires a reset to recover
04h	Library Hardware D	M	C	The library has a hardware fault: 1. Turn the library off then on again. 2. Restart the operation. 3. If the problem persists, call the library supplier help line. Check the library users manual for device specific instructions on turning the device power on and off.	The changer mechanism has a hardware fault that is not mechanically related or requires a power cycle to recover
05h	Library Diagnostics Required	O	W	The library mechanism may have a hardware fault. Run extended diagnostics to verify and diagnose the problem. Check the library users manual for device specific instructions on running extended diagnostic tests.	The changer mechanism may have a hardware fault that would be identified by extended diagnostics .
06h	Library Interface	O	C	The library has a problem with the host interface: 1. Check the cables and connections. 2. Restart the operation.	The library has identified an interface fault
07h	Predictive Failure	O	W	A hardware failure of the library is predicted. Call the library supplier help line.	Predictive failure of library hardware

Type Key:
M – Mandatory
O - Optional

Flag Type Key:
C – Critical
W - Warning
I - Information

Table A.1 — TapeAlert Flags for media changers (part 2 of 4)

Code	Flag	Type	Flag Type	Recommended application client message	Probable cause
08h	Library Maintenance	O	W	Preventive maintenance of the library is required. Check the library users manual for device specific preventative maintenance tasks, or call your library supplier help line.	Library preventative maintenance required
09h	Library Humidity Limits	O	C	General environmental conditions inside the library are outside the specified humidity range.	Library humidity limits exceeded
0Ah	Library Temperature Limits	O	C	General environmental conditions inside the library are outside the specified temperature range.	Library temperature limits exceeded
0Bh	Library Voltage Limits	O	C	The voltage supply to the library is outside the specified range. There is a potential problem with the power supply or failure of a redundant power supply.	Library voltage limits exceeded
0Ch	Library Stray Tape	O	C	A cartridge has been left inside the library by a previous hardware fault: 1. Insert an empty magazine to clear the fault. 2. If the fault does not clear, turn the library off and then on again. 3. If the problem persists, call the library supplier help line.	Stray cartridge left in library after previous error recovery
0Dh	Library Pick Retry	M	W	There is a potential problem with the drive ejecting cartridges or with the library mechanism picking a cartridge from a slot. 1. No action needs to be taken at this time. 2. If the problem persists, call the library supplier help line.	Operation to pick a cartridge from a slot had to perform an excessive number of retries before succeeding
0Eh	Library Place Retry	M	W	There is a potential problem with the library mechanism placing a cartridge into a slot. 1. No action needs to be taken at this time. 2. If the problem persists, call the library supplier help line.	Operation to place a cartridge in a slot had to perform an excessive number of retries before succeeding
0Fh	Library Load Retry	M	W	There is a potential problem with the drive or the library mechanism loading cartridges, or an incompatible cartridge.	Operation to load a cartridge in a drive had to perform an excessive number of retries before succeeding
10h	Library Door	M	C	The library has failed because the door is open: 1. Clear any obstructions from the library door. 2. Close the library door. 3. If the problem persists, call the library supplier help line.	Changer door open prevents library functioning
11h	Library Mailslot	O	C	There is a mechanical problem with the library media import/export mailslot.	Mechanical problem with import/export mailslot

Type Key:
M - Mandatory
O - Optional

Flag Type Key:
C - Critical
W - Warning
I - Information

Table A.1 — TapeAlert Flags for media changers (part 3 of 4)

Code	Flag	Type	Flag Type	Recommended application client message	Probable cause
12h	Library Magazine	O	C	The library cannot operate without the magazine. 1. Insert the magazine into the library. 2. Restart the operation.	Library magazine not present
13h	Library Security	O	W	Library security has been compromised.	Library door opened then closed during operation
14h	Library Security Mode	O	I	The library security mode has been changed. The library has either been put into secure mode, or the library has exited the secure mode. This is for information purposes only. No action is required.	Library security mode changed
15h	Library Offline	O	I	The library has been manually turned offline and is unavailable for use.	Library manually turned offline
16h	Library Drive Offline	O	I	A drive inside the library has been taken offline. This is for information purposes only. No action is required.	Library turned internal drive offline.
17h	Library Scan Retry	M	W	There is a potential problem with the bar code label or the scanner hardware in the library mechanism. 1. No action needs to be taken at this time. 2. If the problem persists, call the library supplier help line.	Operation to scan the bar code on a cartridge had to perform and excessive number of retries before succeeding
18h	Library Inventory	O	C	The library has detected an inconsistency in its inventory. 1. Redo the library inventory to correct inconsistency. 2. Restart the operation. Check the applications users manual or the hardware users manual for specific instructions on redoing the library inventory.	Inconsistent media inventory
19h	Library Illegal Operation	O	W	A library operation has been attempted that is invalid at this time.	Illegal operation detected
1Ah	Dual-Port Interface Error	O	W	A redundant interface port on the library has failed.	Failure of one interface port in a dual-port configuration
1Bh	Cooling Fan Failure	O	W	A library cooling fan has failed.	One or more fans inside the library have failed. Internal flag state only cleared when all flags are working again
1Ch	Power Supply	O	W	A redundant power supply has failed inside the library. Check the library users manual for instructions on replacing the failed power supply.	Redundant power supply failure inside the library subsystem

Type Key:
M - Mandatory
O - Optional

Flag Type Key:
C - Critical
W - Warning
I - Information

Table A.1 — TapeAlert Flags for media changers (part 4 of 4)

Code	Flag	Type	Flag Type	Recommended application client message	Probable cause
1Dh	Power Consumption	O	W	The library power consumption is outside the specified range.	Power consumption of one or more devices inside the library is outside the specified range
1Eh	Pass-through mechanism failure	O	C	A failure has occurred in the cartridge pass-through mechanism between two library modules.	Error occurred in pass-through mechanism during self test or while attempting to transfer a cartridge between library modules
1Fh	Cartridge in pass-through mechanism	O	C	A cartridge has been left in the pass-through mechanism from a previous hardware fault. Check the library users guide for instructions on clearing this fault.	Cartridge left in the pass-through mechanism between two library modules
20h	Unreadable bar code labels	O	I	The library was unable to read the bar code on a cartridge.	Unable to read a bar code label on a cartridge during library inventory/scan
21h	Library Capacity Exceeded	O	C	The total number of volumes exceeds the available number of storage elements. Remove a cartridge from the inventory to recover.	User filled all storage elements while there was a cartridge in the drive
22h	No Cleaning Cartridge	O	W	The library is managing cleaning of the tape drive(s), but there is no cleaning cartridge available in the inventory. Add a cleaning cartridge to the inventory to recover.	No cleaning cartridge available
23h	Expired Cleaning Cartridge	O	W	At least one of the cleaning cartridges has expired. Replace the expired cleaning cartridge with a new cleaning cartridge to recover.	Expired cleaning cartridge

Type Key:
M - Mandatory
O - Optional

Flag Type Key:
C - Critical
W - Warning
I – Information